Clegg

10 WATT 222 MHz FM TRANSCEIVER

FM-76

OWNER'S MANUAL

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SECTION I SPECIFICATIONS

Aug 1, 1978
W1AZP

GENERAL:

Frequency coverage	220.00 to 225.00 MHz
Number of Transistors	Transistors ········ 30
	FET ········ 2
	IC ········ 1
	Diodes ········ 12
Modulation Type	16F3
Power Voltage	DC 13.8V ±15% negative ground
Current Drain	Transmit:
	HI (10W) average 3.1A
	LOW (1W) average 1.1A
	Receive: squelched 220mA
Antenna Input	50 ohms
Size	2-1/4" (H) x 6-3/8" (W) x 8-7/8" (D)
Weight	4-1/2 lbs.

TRANSMITTER:

RF Power Output	HI ········ 10W
	LOW ········ 1W
Frequency Control	Crystal (18MHz) multiplied x 12
Maximum Frequency Deviation	±5 kHz
Audio Input	10K ohms
Modulation System	Variable reactance phase modulation
Microphone	10K ohms-Dynamic microphone with push button switch
Spurious Emission	-60 dB

RECEIVER: Certified to comply with FCC part 15.

Reception Frequencies	12 channels for 223 MHz band
	Built-in crystal units for 1 channel
Reception System	Double Superheterodyne
Intermediate Frequencies	1st IF: 10.7 MHz
	2nd IF: 455 kHz
Sensitivity	a. Better than 0.5μV 20dB quieting
	b. S + N/N at 0.5μV input, 12 dB or more.
Spurious Response	-60 dB
Squelch Threshold	Less than 0.3μV
Band width	kHz/–6 dB point
	±12 kHz/–50 dB
Audio output power	2.0W
Audio output impedance	8 ohms
Frequency control	Crystal (53 MHz) multiplied x 4

ACCESSORIES:

The following accessories for the Clegg FM-76 are included.

1. Microphone (dynamic type)	1
2. Microphone hanger	1
3. Spare fuse (3A)	2
4. Mounting bracket	1
5. Mounting bracket studs	4
6. Channel frequency ID card	1
7. Instruction Manual	1
8. External speaker plug	1
9. 4 prong plug or Tone Burst Generator and Discriminator Meter	1
10. Crystals (installed) for 223.50 MHz SIMPLEX	

SECTION II DESCRIPTION

The Clegg FM-76 is an extremely rugged, completely solid state transceiver, Electrical design, mechanical construction and component selection assure reliable, high quality performance.

The compact, low profile packaging and convenient mobile mounting bracket facilitates convenient mounting in any vehicle. The clean, simple panel layout provides for ease of operation.

Although the FM-76 has been designed principally for mobile operation its attractive appearance and electrical performance suit it admirable for base station operation with an external power supply. The large S meter enhances beam orientation; the excellent front and selectivity provides good immunity from cross modulation.

The dual conversion receiver with its FET front end and high-Q helicalized cavity resonators produce sensitivity of 0.5 uV or less. Signal gain of 90 dB or more is accomplished from the second mixer back by virtue of 3 stage of IF amplifier (1 transistor and 2 ICs). The need for additional front end RF amplification is thus eliminated. Zener regulated crystal-controlled first and second local oscillators produce unmatched stability. Audio reproduction is of an unusually high order of distortion free clarity.

The transmitter section will produce a nominal of 10 watts RF output. Again, a zener regulated crystal oscillator is employed for initial frequency stability. Twelve crystal controlled channels are provided for operating convenience and versatility. High-Q and shielded stages provided minimum interstage spurious reaction.

An encased low pass filter is placed at the output to further insure undersirable frequency products not being emitted. An Ingenious final PA transistor protection device (APC), is incorporated in the final output circuitry. A tiny VSWR bridge and four DC amplifiers constantly monitor the output for high VSWR, a shorted or absent antenna load or other difficulty that would cause irreparable final transistor damage. Should these difficulties occur, the APC instantaneously disables the driver and final PA without damage.

All circuitry is constructed in a series of module which are easily removable for servicing.

Each unit comes complete with built-in speaker, a high-quality dynamic microphone, mobile mounting bracket, microphone hanger, and operating manual.

SECTION III INSTALLATION

3.1 Unpacking:
Carefully remove your transceiver from the packing carton and examine it for signs of shipping damage. Should any shipping damage be apparent, notify the delivering carrier immediately, stating the full extent of the damage. It is recommended you keep the shipping carton. In the event storage, moving, or reshipment becomes necessary, they come in handy. Accessory hardware, cables, etc. are packed with the transceiver. Make sure you have not overlooked anything.

3.2 Location:
Where you place the transceiver in your automobile is not critical and should be governed by convenience and accessibility entirely. Since the unit is so compact, many mobile possibilities present themselves. In general, the mobile mounting bracket will provide you with some guide as to placement. Any place where it can be mounted with metal screws, bolts, or pop-rivets will work.

3.3 Power Requirements:

The transceiver is supplied ready to operate from any regulated 13.8V DC, 3.2 ampere negative ground source. An automobile, 12 volt, negative ground, system is usually more than adequate. Some note must be taken, however, to the condition of the vehicle's electrical system. Problems such as low battery, worn generator/alternator, poor voltage regulator, etc., will impair operation of your transceiver as well as the vehicle. High noise generation or low voltage delivery can be traced to these deficiencies. If an AC power supply is used with your transceiver, make certain it is adequately regulated for both voltage and current. Low voltage while under load will not produce satisfactory results from your transceiver. Receiver gain and transmitter output will be greatly impaired.

CAUTION: Excessive Voltage (above 16VDC) will damage to your transceiver. Be sure to check the source voltage before connecting the power cord.

Included with your transceiver is a DC power cable. The red wire positive (+), and the black wire is negative (—). If your mobile installation permits, it is best to connect these directly to the battery terminals. The arrangement eliminated random noise and transient spikes sometimes found springing from automotive accessory wiring. If such an arrangement is not possible, then any convenient B+ lead in the interior of the vehicle and the negative from can be utilized. Your transceiver provides an internal DC filter'that will take out the large amount of transient difficultire anyway. Remember, the unit operates on a negative ground system only-it cannot be used in a positive ground automobile.

If an AC power supply is used with your transceiver, make certain it is adequately regulated for both voltage and current. Low voltage while under load will not produce satisfactory results from your transceiver. Receiver gain and transmitter output will be greatly impaired.

3.4 Antenna:

The most important single item that will influence the performance of any communications system is the antenna. For that reason, a good, high-quality, gain antenna of 50 ohms impedance is recommended.

When adjusting your antenna, whether mobile or fixed, by all means follow the manufacturer's instructions. There are some pitfalls to be aware of. For example: do not attempt to adjust an antenna for lowest VSWR when using a diode VSWR meter note engineered for VHF applications. Such readings will invariably have an error of 40% or more. Rather, use an in line watt meter similar to Bird Model 43 with VHF cartridge. Further, when adjusting a mobile antenna, do so with the motor running preferably above normal idling speed. This will insure proper voltage level to the transceiver.

Do not become alarmed if your transceiver fails to transmit at times during the antenna tune up procedure. Remember, your transceiver has a built-in Automatic Protection Circuit (APC) that will disable the transmitter if excessive VSWR, a short coaxial line or connector, or other antenna deficiency is present. A quick check on a good 50 ohm dummy load will show the transceiver to be working. The difficulty will lie with the antenna or its transmission line.

The RF coaxial connector on the rear chassis mates with a standard PL-259 connector.

3.5 Microphone:

A high quality dynamic microphone is supplied with your transceiver. Merely plug it into the proper receptacle on the front panel. Should you wish to use a different microphone, make certain it is of the high impedance type; at least 10K ohms or better. Particular care should be exercised in wiring also, as the internal electronic switching system is dependant upon it. See the schematic for the proper hook up. Under no circumstances use a "gain pre-amp" type microphone. The audio system in your transceiver is more than adequate and additional pre-amplification is unnecessary. To use this class of microphone is to invite distortion and possible damage to the transceiver.

3.6 Crystals:

Your transceiver has twelve channels, both transmit and receive, or a total of 24 crystal positions. The channel selector switch selects one transmit and one receive channel in each of its twelve positions.

Transmit and Receive crystals for most commonly used channels are available directly from Clegg inventory and may be ordered by mail or telephone. Crystals may, of course, be purchased from any of the reliable crystal sources advertising in the various ham periodicals. They should be ordered to the following specifications.

Crystal Data

1) Transmitter crystal
Holder type : HC-25/U
OSC. Mode : Fundamental
Pin to pin capacitance : 7pF Max. 4 pF Min.
Load capacitance : 30pF
Series resistance : 25 ohms Max.
Frequency tolerance : ±0.001% at 25°C
Crystal frequency : $\frac{\text{Desired operating frequency}}{12}$
Frequency Stability : ±0.001% (−20°C +50°C)

2) Receiver crystal
Holder type : HC-25/U
OSC. Mode : 3rd Overtone
Pin to pin capacitance : 7pF Max., 4pF Min.
Load capacitance : 20pF
Series resistance : 40 ohms Max.
Frequency tolerance : ±0.001% at 25°C
Crystal frequency : $\frac{\text{Desired operating frequency } -10.7\text{MHz}}{4}$
Frequency stability : ±0.001% (−20°C +50°C)

Trimmers have been placed on the crystal board to assist you in adjusting new crystals on frequency. Consult the trimmer location chart (Fig. 1) for their positions.

The amount of frequency spread between any two receiving or any two transmitting frequencies should not exceed 2 MHz. Since the receiver and transmitter are independent of each other, you may have any practical amount of frequency separation you wish here. Only two or more widely spaced frequencies for the receiver alone or for the transmitter alone need be considered under the 2 MHz limitation.

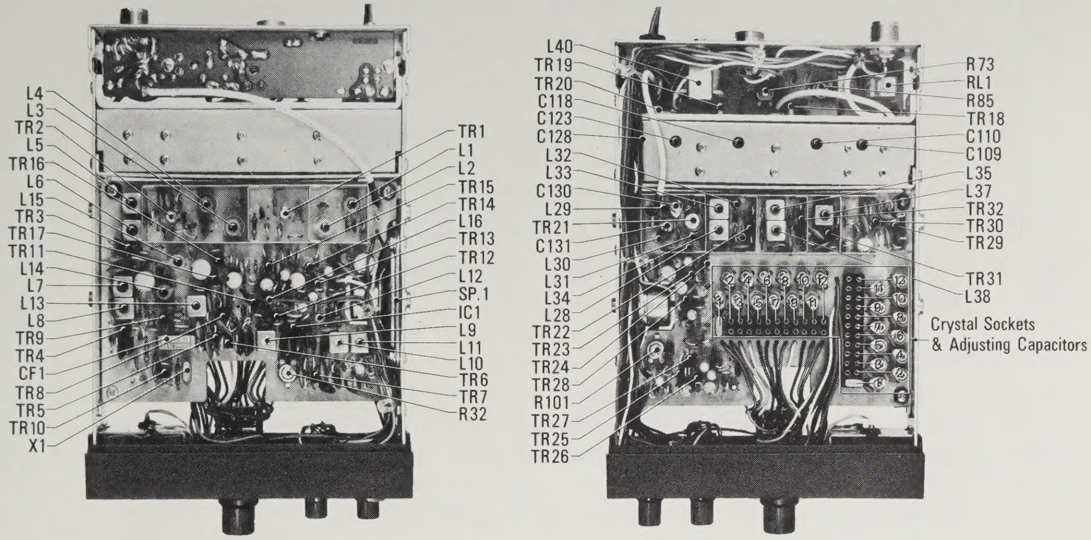

FIG. 1

3.7 External speaker jack and plug is supplies with your unit in the event another speaker is desirable. The external speaker impedance should be 8 ohms. The use of external speaker jack will disable the internal speaker. An 8 ohm headset can be utilized as well.

SECTION IV CONTROL FUNCTIONS

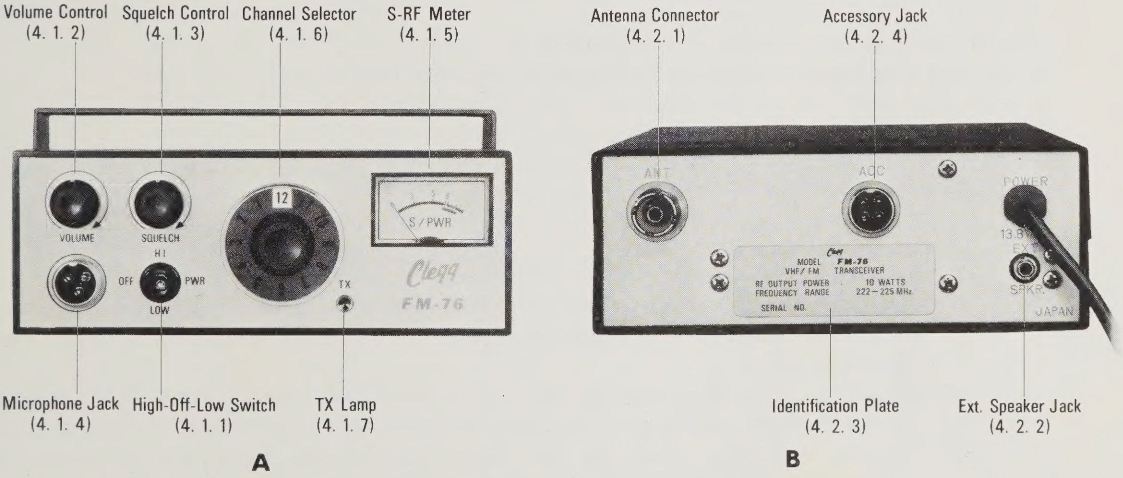

FIG. 2

4.1 Front control and jack (Fig. 2-A)

4.1.1 High-Off-Low Switch: opens or closes the 13.8 VDC source voltage to the transceiver. In "high" position, output power is 10 watts. In "low" position output power is 1 watt.

4.1.2 Volume Control: controls audio output level of the receiver.

4.1.3 Squelch Control: controls the squelch threshold point of the receiver.

4.1.4 Microphone Jack: accepts 3 prong mike plug supplied on microphone.

4.1.5 S-RF Meter: reads S signal strength in receive mode and relative RF output in transmit mode. The meter face is illuminated with a white lamp when the transceiver is switched on in in-receive condition.

4.1.6 Channel selector: selects one of twelve pairs of transmit receive crystals.

4.1.7 TX Lamp: Comes on when microphone PTT button is pressed and transmitter is on the air.

4.2 Rear Panel (Fig. 2-B)

4.2.1 Antenna Connector: Accepts standards PL-259 coaxial connector. Note: Some transceivers may come with a metric threaded connector. If this is the case, a mating metric PL-259 is supplied also. Most PL-259 connectors will mate satisfactorily if care is taken to seat them properly. If you have difficulty, try a different make of PL-259.

4.2.2 External Speaker Jack:
This jack mates with the accessory Ext. speaker Plug supplied for external 8 ohm speaker or headset use. The use of this jack mutes the internal speaker.

4.2.3 Identification Plant:
States model, serial number, RF output power and frequency range, Note: It would be well to make a separate record of the serial number of your unit for insurance purposes.

4.2.4 Accessory Jack:
Accepts accessory 4 prong Plug supplied for tone-burst and discriminator meter.
It would have as connections:

1. Tone audio input (10mV)
2. 12 volt negative (ground)
3. Transmit keyed 12 VDC positive
4. Discriminator meter connection (See Section 7-2-d)

SECTION V OPERATION

5.1 Initial Preparations:

a. Connect the microphone to the microphone jack.
b. Connect the antenna to the antenna coax connector. Make sure the coax line is of the correct impedance (50 ohms) and is neither shorted nor open circuited.
c. Make sure the function switch is in the off position. The red lead should be connected to the positive side of the power source and the black lead to the negative side. In the even that these leads are improperly connected, the MARK 3 will not function. No damage will be incurred since protection is provided for this purpose.
d. Turn the volume and squelch controls to the maximum counter clockwise position.

5.2 Operation:

a. When the function switch is set to either the "HI" or "LOW" position, the set is switched on, and the channel indicator window and meter will be illuminated.

b. Switch the channel selector to the desired channel.

5.3 Reception:

a. Adjust the volume control to a comfortable listening level of noise, if no signal is present.

b. Carefully adjust the squelch control clockwise until the noise just disappears. This is the proper squelch threshold setting and must be done when no signal is received which opens the squelch. If the squelch is unstable due to the reception of weak or unstable stations, adjust the squelth control further until the proper threshold is obtained.

c. The S meter indicates the signal strength of the incoming stations and is calibrated in S units. An input signal of approximately 5μv will provide an S9 reading.

5.4 Transmitting:

a. Push the PTT (push to talk) button on the microphone and the transceiver is set for transmitting. At the same time, the TX Lamp is illuminated and the meter provides an indication of relative power output of the transmitter. The pointer will be on or near the red mark on the meter scale when on high power and just a little over on low power.

b. Hold the microphone about three inches from your mouth and speak in a normal voice. Shouting does not increase your communication range, but a good antenna does. The microphone is of the dynamic type and provides good pickup for all levels of the voice.

c. To receive again, just release the PTT button. This will also switch off the red illumination of the Lamp.

5.5 Function Switch:

a. You can select the proper output power according to the communication distance to be covered or conditions. When using the FM-76 as a driver or exciter for an amplifier, the function switch can be set to the low power position and the power output adjusted as described in the Power Supply section. This will provide the required amount of drive for the linear amplifier without wasting power in swamping resistors, etc. When the switch is set on "HI", the power output will be 10 watts; on "LOW" the output will be 1 watt.

SECTION VI THEORY OF OPERATION

6.1 Receiver RF Amplifier and 1st Mixer:
The input signal passed through the pre-selector circuit (C1, C2, C3, C4, L1 and L2) is amplified by TR1 (MOS-FET) and fed into 1st Mixer TR2 (MOS-FET) through Double-tuned Filter (L3 and L4).

6.2 Receiver 1st Local Oscillator:
3rd overtone crystal (53 MHz) is oscillated at 1st Local Oscillator (TR8) with several KHz adjustment by the trimmer capacitor built in series with crystal. The output of the 1st Local Oscillator is multiplied by four times at Multiplier (TR9), and then fed into the 1st Mixer (TR2), giving the 1st I.F. of 10.7 MHz.

6.3 Receiver 1st IF amplifier, 2nd Mixer, 2nd Local Oscillator, 2nd IF Amplifier, Limitter, Discriminator and Meter Amplifier:

The output from the 1st Mixer (10.7 MHz) is amplified by TR3 and fed to the 2nd Mixer (base of TR4). Also, the 2nd Local Frequency (10.245 MHz) is coupled into the 2nd Mixer through crystal control oscillator (emitter of TR10) to get the output of the 2nd Mixer (455 KHz). The 2nd IF signal is amplified and limited by TR5 and TR6, and then is detected by the Discriminator circuit consisted of L10, L11, D2 and D3. The Meter Amplifier (TR7) amplifies a part of output of the 2nd IF Amplifier (TR6) and detect it with D1 to feed into the Meter.

6.4 Receiver Audio Amplifier and Squelch Amplifier:
The audio signal from Discriminator circuit is adjusted by Volume Control (R27) and amplified by Audio Amplifier (TR14, TR15). This output signal is further amplified up to 2 watts by the Complementary Power Amplifier (TR16, TR17) and then fed into Speaker.

The noise signal (with the main element of 40 KHz) from Discriminator is controlled by Squelch Control (R50) and fed into the Noise Amplifier (TR11, TR12). The amplified noise signal is detected by D4 and D5 and coupled into DC Switching Amplifier (TR13).

When there is no RF signal, the noise signal from the Discriminator increases and the DC Switching Amplifier (TR13) is set on. In such case, Audio is cut-off since the collector of TR13 and the base of TR14 (Audio Amplifier) become zero level. While, when RF signal comes in, TR13 is set off and TR14 (Audio Amplifier) operates properly.

6.5 Power Source Filter:
The DC Filter (L40 and C206) protects the transceiver from the damages caused by surge and spike voltage, and also from the noises. D11 is also provided to protect the transceiver from the damage caused by miss connection of the power cord.

6.6 Transmitter Crystal Oscillator and Phase Modulator:
TR29 is a fundamental crystal oscillator of 18 MHz. The frequency adjustment in the range of several kHz, is made by the trimmer capacitors built in the series with crystals. The output of the Oscillator is coupled into the base of TR30 (Phase Modulator) and receive the Phase Modulation togethr with the Transmitter Audio Signal coming into the base of TR30.

FCC Form 76-K
July 1974

FEDERAL COMMUNICATIONS COMMISSION

FEE SCHEDULE FOR SPECIFIED SERVICES

(FOR EXCEPTIONS AND FEES FOR OTHER SERVICES,
SEE SUBPART G OF PART I OF THE COMMISSION'S RULES)

COMMERCIAL OPERATOR RADIOTELEPHONE AND RADIOTELEGRAPH LICENSES AND PERMITS:

First Class (new, duplicate, renewal, replacement)	$ 5.00
Secondo Class (new, duplicate, renewal, replacement)	$ 4.00
Third Class (new, duplicate, renewal, replacement)	$ 3.00
Provisional Certificate for Radiotelephone Third Class Operator Permit with Broadcast Endorsement	$ 2.00
License Verification Card	$ 2.00
Separate Application for Endorsement of License	$ 2.00
Restricted Radiotelephone Operator Permit (new, replacement) -	
U. S. Citizen, lifetime permit	$ 8.00
Alien, Aircraft Pilot (5-year term renewable)	$ 2.00

AMATEUR RADIO SERVICE: *

Initial License, Renewal, New Class of Operator License	$ 4.00
Modification of License without Renewal	$ 4.00
Modification of License with Renewal	$ 9.00
Special Call Sign - (Plus any other applicable fee)	$ 25.00

AVIATION RADIO SERVICE: *

Microwave stations (new, renewal, or assignment)	$ 75.00
All other applications	$ 20.00

CITIZENS RADIO SERVICE: *

Application for Station License	$ 4.00

INDUSTRIAL, LAND TRANSPORTATION, AND PUBLIC SAFETY SERVICES: *

Initial license, modification, renewal, or assignment	$ 20.00
Microwave station (new, renewal, or assignment)	$ 75.00
Microwave station modification without renewal	$ 20.00
Microwave station used in CATV systems yearly renewal	$ 15.00

MARINE RADIO SERVICE: *

Ship Station License	$ 20.00
Ship Station License with request for Interim Ship License (See Instruction F on FCC Form 502 or Part 83 of Commission's rules)	$ 25.00
Microwave stations (new, renewal, or assignment)	$ 75.00
Common Carrier Public Coast Stations (new, renewal, or assignment)	$ 75.00
All other applications (including exemptions from ship radio station requirements)	$ 20.00

* DUPLICATE STATION LICENSE FOR THE SAFETY AND SPECIAL RADIO SERVICES	$ 6.00

COMMON CARRIER RADIO SERVICES:

Individual Mobile Radiotelephone License	$ 50.00
Each Additional Unit	$ 30.00

MODEL ______________________

	TX	RX
1.	223.50	223.50
2.	221.36	224.96
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

80PZ3M

CLEGG COMMUNICATIONS CORP.
1911 Old Homestead Lane
LANCASTER, PA 17601
(717) 299-7221

CUSTOMER'S ORDER NO.	PHONE	DATE
		August 1, 1978

NAME
A. J. Mitchell

ADDRESS
145 River Valley Road
Stratford, CT 06497

SOLD BY	CASH	C.O.D.	CHARGE	ON ACCT	MDSE. RET'D.	PAID OUT
			M/C			

QTY.	DESCRIPTION	PRICE	AMOUNT
1	FM-76 S/N 761067		165 00
1pr	Crystals Installed		8 00
	Shipping & Handling		1 75
	TOTAL		174 75
	Charged to Master Charge #53005 01 01737 9 Exp. 4/80 I/B 1230		
		TAX	
		TOTAL	

RECEIVED BY
SENT BY UPS ON 8-2-78

15908

All claims and returned goods MUST be accompanied by this bill.

Thank You

SERIES 610

Thank You! WE APPRECIATE YOUR BUSINESS

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PROMISSORY NOTE

[illegible] Date [illegible] 19

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6.7 Transmitter Audio Amplifier:
The audio signal from microphone is amplified by TR25 and then further amplified and limitted by limitter transistor TR26.

The pre-emphasis circuit is formed as feedback type with C154, R95, C153, R90 and R89. The output signal from the AF Amplifier (TR26) is coupled into the Phase Modulator circuit (TR13) through the Integrator Circuit (TR28) and Active Audio Filter (TR27).

6.8 Transmitter Multiplier:
The output from the Phase Modulator (TR30) is multiplied twelve times to a final frequency of 220 MHz through TR31, TR32, TR22 and TR21. These transistors act as, in order, a frequency tripler, buffer amplifier, and frequency doublers.

6.9 Transmitter Power Amplifier Block:
The output signal from the multiplier is amplied to 10 watts by TR20, TR19 and TR18, and then coupled into the APC (Automatic Protection Circuit).

6.10 APC (Automatic Protection Circuit) and Transmitter Power Monitor Circuit:
A part of 10 watt output from the Power Amplifier Block is coupled by C105 and detected by D10 to be fed into the Meter to indicate as power monitor. The large portion of the RF output is fed into the Antenna Connector through VSWR Bridge and the Relay (RL1).

APC acts as protection to decrease the output of TR22, if the antenna is seriously mis-matched. A reflected power is detected by D9. When the antenna is mismatched, this circuit senses a high reflected power and provides a base drive to TR23. TR23 will conduct sufficient base drive to reduce the base drive of TR24. When TR24 begins to turn off, it reduces the Emitter current of TR22. As result, the power output of Power Amplifier Circuit (TR18) is reduced to a safe value. Thus, when the antenna is mismatched, APC protects from the damage.

SECTION VII MAINTENANCE

7.1 Overall Alignment:
The Clegg FM-76 has been factory aligned to produce full specified performance over the 222 to 224 MHz range on transmit and 223 to 225 MHz range on receive. Only when operation is required over a different portion of the 222 MHz band or after replacement of a major component should realignment of necessary.

If realignment is indicated it is recommended that the owner contact Clegg Division, Service Manager for detailed instructions.

7.2 Frequency Netting, Transmitter:

a. Remove the eight self tapping screws on the both sides of the cabinet. Separate the Chassis from the cabinet.

b. Connect a dummy load (50 ohms) or a wattmeter to coax connector.

c. Connect the microphone to the microphone jack.

d. To align the transmitter on a desired frequency, switch the channel control to the desired channel. Slowly adjust the trimmer capacitor for that channel until the desired frequency is achieved. Consult Fig. 1 for the location of the proper trimmer. These trimmers should be adjusted very slowly while the transmit frequency is observed on suitable measuring equipment. Another FM-76 equipped with a discriminator meter can serve well for this purpose. However, it must be adapted. This adaptation can be accomplished by installing a 50 microampare ϕ center meter. Install the meter to accessory plug (4 pin, and ground 2 pin). With the FM-76 meter installed, in the receive mode on the channel desired, adjust the trimmer capacitor for the null point on the meter.

e. The multipliers, driver and power output stages should be aligned on LOW power first then set the function switch on HIGH power. Align these stages according to the alignment chart provided. (See Alignment Chart).

Be carefull not to transmit for more than 5 second during each alignment step. As damage could be caused to the transistors due to overload during this procedure.

7.3 Frequency Netting, Receiver:

a. Remove the microphone form the transceiver to prevent accidental transmission during receiver alignment.

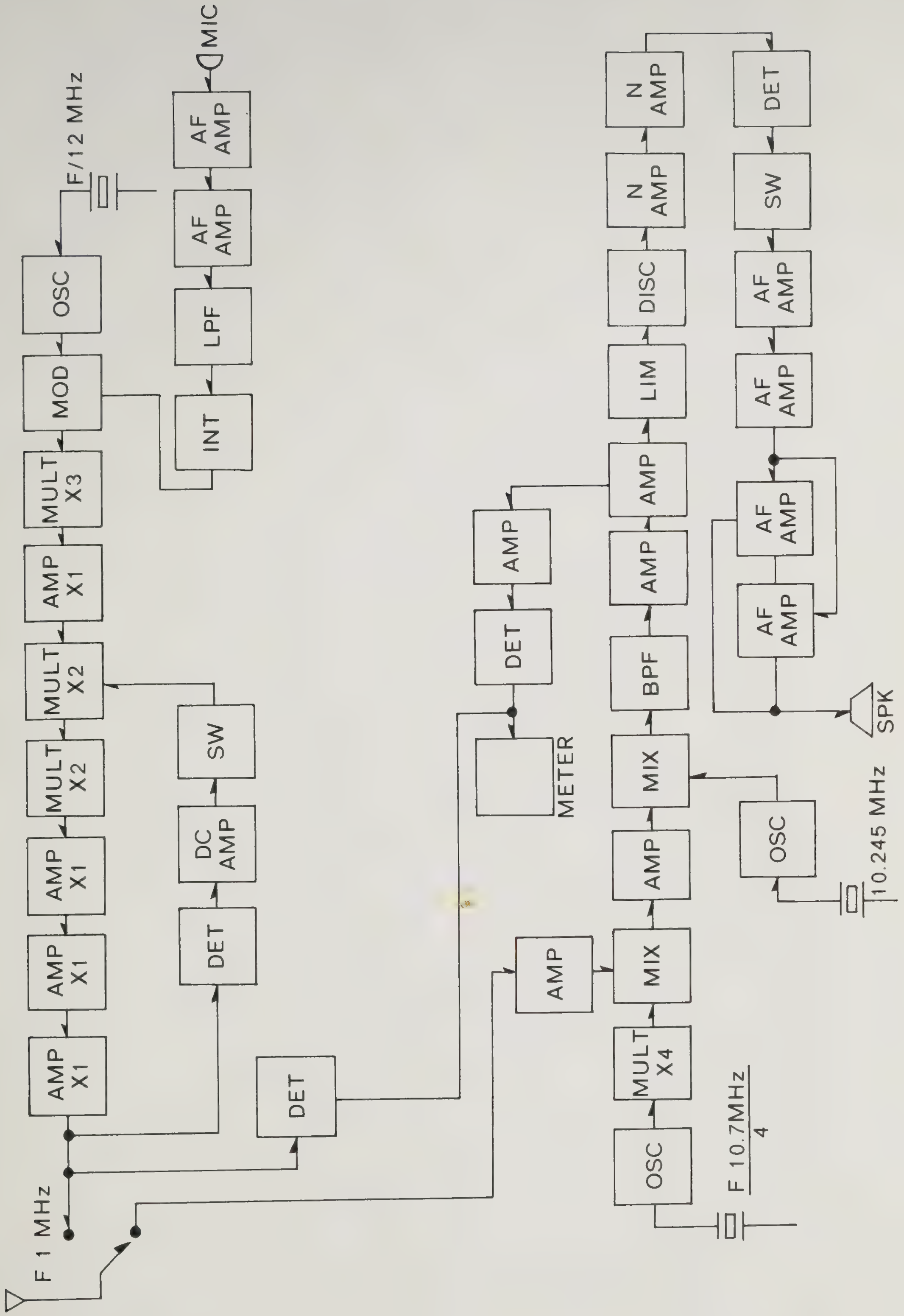
b. Allow the test oscillator or generator to stabilize output frequency drift.

c. Connect the test oscillator or generator to the antenna coax connector. Set the test oscillator or generator to the desired frequency. Set the squelch control to the maximum counter clockwise position.

d. Align the receiver accrding to the chart provided. (See Alignment Chart).

e. When setting the receiver to a desired frequency, a discriminator meter should be connected to Accessory Plug and the receiver trimmer capacitors adjusted to cause the S meter to read a maximum and the discriminator meter to read zero. Refer to Fig. 1 for the location of the proper trimmer corresponding to discriminator meter.

FM-76 BLOCK DIAGRAM



ALIGNMENT CHART

FM-76 VOLTAGE CHART

NO.	NAME	GATE 1	GATE 2	SOURCE	DRAIN	REMARKS
TR 1	3SK35	0	3.6	0	12.8	
2	3SK35	0	0	3.5	8.5	

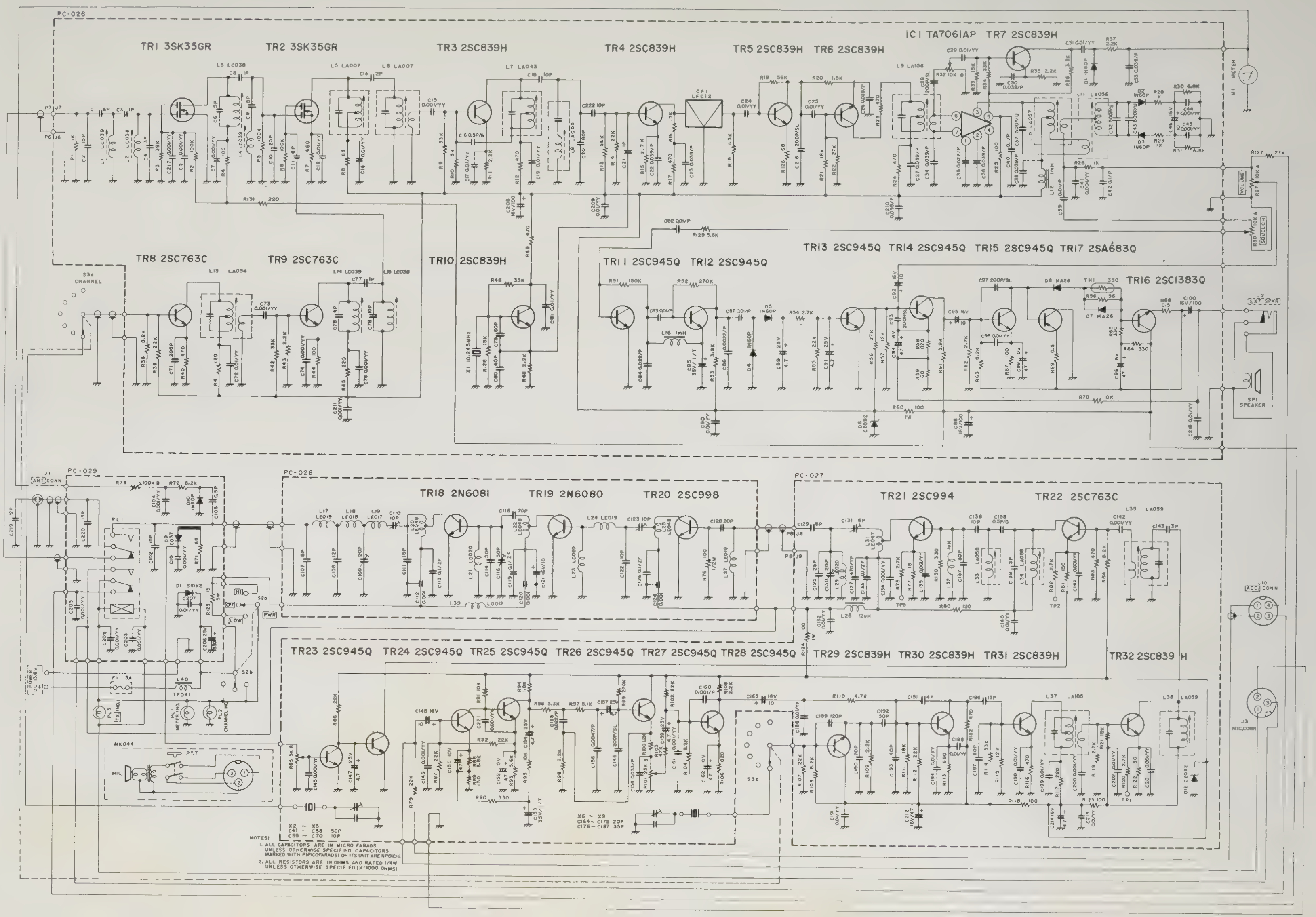
NO.	NAME	# 1	# 2	# 3	# 4	# 5	# 6	# 7	REMARKS
IC 1	TA7061AP	1.9	1.9	8.6	0	7.8	1.9	1.9	

NO.	NAME	BASE	EMITTER	COLLECTOR	REMARKS
TR 3	2SC839	2.4	2.0	8.3	
4	2SC839	2.1(2.1)	2.0(1.7)	7.3(7.5)	2nd Local osc. ON(OFF)
5	2SC839	0.75	0.11	1.1	
6	2SC839	3.3	2.8	7.8	
7	2SC839	2.1	1.7	5.3	
8	2SC763	2.5(2.1)	1.6(1.5)	8.4(8.4)	( ) ; Vacant Channel
9	2SC763	0.5(0.5)	0.45(0)	8.6(8.8)	( ) ; Vacant Channel
10	2SC839	2.3(2.3)	3.2(1.8)	7.8(8.2)	2nd Local osc. ON (OFF)
11	2SC945	0.6(0.6)	0	1.9(1.4)	Unsquelched (Squelched)
12	2SC945	1.7(1.3)	1.9(1.4)	4.6(6.0)	Unsquelched (Squelched)
13	2SC945	0(0.6)	0	2.4(0.02)	Unsquelched (Squelched)
14	2SC945	2.4(0.02)	1.9(0)	4.9(13.5)	Unsquelched (Squelched)
15	2SC945	1.6	0.95	6.3	
16	2SC1383	7.4	6.8	13.5	
17	2SA683	6.3	0	6.8	
18	2N6081	0	0	12.5(2.4)	HI Power (Low Power)
19	2N6080	0	0	12.5(2.4)	HI Power (Low Power)
20	2SC998	0	0	12.5(12.5)	HI Power (Low Power)
21	2SC994	0	1.1(0)	12.5(13.0)	( ) ; Vacant Channcl
22	2SC763	0.7(0.9)	1.6(0.4)	12.5(13.0)	( ) ; Vacant Channcl
23	2SC945	0(0.55)	0	0.6(0.6)	( ) ; Absent Antenna at HI
24	2SC945	0.6(0.6)	0	0.02(1.6)	( ) ; Absent Antenna at HI
25	2SC945	2.4	1.9	5.9	
26	2SC945	5.8	5.3	6.8	
27	2SC945	2.4	1.9	5.8	
28	2SC945	2.1	1.6	4.3	
29	2SC839	5.5(5.6)	5.4(5.0)	7.9(8.0)	( ) ; Vacant Channel
30	2SC839	3.1(3.3)	2.6(2.5)	7.9(8.0)	( ) ; Vacant Channel
31	2SC839	1.5(1.7)	2.0(1.2)	7.6(8.1)	( ) ; Vacant Channel
32	2SC839	0.9(1.0)	1.0(0.4)	8.0(8.5)	( ) ; Vacant Channel

Note: 1. They were measured by DC Volt Meter 33.3KΩ/V, ±3%.

2. Datas, From TR18 to TR32 were measured by DC Volt-Meter (Note 1) with 10KΩ Resistor of it's probe.

CIRCUIT DIAGRAM



NOTES:
1. ALL CAPACITORS ARE IN MICRO FARADS UNLESS OTHERWISE SPECIFIED CAPACITORS MARKED WITH P(PICOFARADS) OF ITS UNIT ARE NPO(CH).
2. ALL RESISTORS ARE IN OHMS AND RATED 1/4W UNLESS OTHERWISE SPECIFIED.(K=1000 OHMS)

WARRANTY AND SERVICE STATEMENT

CLEGG DIV. of ISC warrants the FM-76 to the free from defects in material and workmanship for a period of 90 days after delivery to the original purchaser. We agree to repair or replace the unit at no charge should it become defective during that period providing, in our opinion and upon our examination, the unit has not been misused or misinstalled.

This warranty shall be invalidated if, the unit has been modified or altered and any subsequent defects are, in our opinion, related to such actions.

Upon conclusion of the 90 day warranty period Clegg Div. will provide factory service on a flat fee basis covering labor and material for a period of not less than 3 years from date of original sale. This fee may vary from time to time and may be dependent on the age of the unit. It will be quoted on request, to the owner prior to his returning the defective product.

CLEGG DIV. OF ISC
208 CENTERVILLE RD.
LANCASTER, PA 17603

Printed in Japan

Clegg

VHF-FM 25WATTS
144 TO 148MHz

PLL AMATEUR TRANSCEIVER

FM-28

OWNER'S MANUAL

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SECTION 1. SPECIFICATIONS

GENERAL

Frequency Coverage : 144.00 to 147.995 MHz in 5 KHz steps
Frequency Control : Digitally synthesized PLL system
Frequency Stability : Temperature: Less than 30 Hz/°C
Voltage: Less than 100 Hz for ±15% change
Semiconductor Complement : 4 Transistors; 11 FETs' 13 IC's
4 LED Displays, 29 Diodes
Modulation Type : 16F3
Supply Voltage : 13.8V DC ±15%, Negative ground
Current Drain : Transmit:
Hi (7A)
LO (2A)
Receive: .8A Average
Antenna Impedance : 50 ohms nominal
Size : 2-5/8(H) x 6-5/8(W) x 10-3/4(D) (exclusive of controls
Weight : Approx. 7 lbs. net; 9 lbs. shipping

TRANSMITTER

Frequency Control : Hetrodyne generated by product of Phase locked VCO and OFFSET Crystal.
Transmit Frequency Offset : Panel selectable for ±600 KHz; SIMPLEX and 2 optional non-standard Repeater Offsets
Modulation : Direct FM; Adjustable 3 to 15 KHz deviation (Factory set at 5 KHz)
Audio Input : 600 ohms
Microphone : 600 ohm dynamic with push to talk switch
Power Output : HI Position 25 watts
LO Position Adjustable from .25 to 4 watts (Approx.)
Spurious Outputs : Down 66 dB (typical) 60 dB (min)
Duty Cycle : 50% HI POWER; 100% LO POWER

RECEIVER

Frequency Scheme : Dual conversion superhetrodyne with 16.9 MHz and .455 MHz IF
Sensitivity : .3 μV (max) for 12 dB SINAD
.2 μV Squelch threshold
Spurious Response : –65 dB (min)
Selectivity : 14 KHz at –3 dB
25 KHz at –70 dB
Audio Output Power : 1.5 watts (min) at 10% THD
Audio Output Impedance : 8 ohms

ACCESSORIES

The following accessories for the Clegg FM-28 are included:

1) Microphone (dynamic type)	1
2) Microphone hanger	1
3) Spare fuse (7A)	1
4) Mobile bracket and hardware	1
5) Instruction Manual	1
6) External Speaker plug	1
7) Accessory plug	1
8) Desk mounting bracket	1
9) DC Power Cables	1

SECTION 2. GENERAL INFORMATION

The FM-28 is a 25 watt, frequency synthesized solid state radio set providing transmission and reception over the 144 to 148 MHz range.

Frequency control employing state of the art digital circuitry combined with a precision phase locked VCO provides 800 receive channels in 5 KHz increments. Receive frequency is displayed in large bright LED numerics.

A unique feature of the FM-28 is its transmit frequency flexibility wherein non-standard Repeater splits up to ±1.5 MHz can be accomodated as the standard ±600 KHz and SIMPLEX.

Although basically designed for mobile applications the FM-28 in conjunction with a Clegg 031, 031A or 060 model Power Supply makes an ideal base station.

Construction is modularized with individual, easily accessible PC boards for each functional circuit section.

SECTION 3. INSTALLATION

3.1 Unpacking:

Carefully remove your transceiver from the packing carton and examine it for signs of shipping damage. Should any shipping damage be apparent, notify the delivering carrier and CLEG immediately, stating the full extent of the damage. It is recommended you keep the shipping carton for future storage, moving, or reshipment. Accessory hardware, cables, etc., are packed with the transceiver. Make sure you have not overlooked anything.

3.2 Location:

Where you place the transceiver in your automobile is not critical and should be governed by convenience and accessibility. Since the unit is so compact, many mobile possibilities present themselves. In general, the mobile mounting bracket will provide you with some guide as to placement. Any place where it can be mounted with metal screws, bolts, or pop-rivets will work. For base station operation, the bracket for desk-top operation places controls at a comfortable position and the internal speaker in an efficient position.

3.3 Power Requirements:

VOLTAGE IN EXCESS OF 16V will cause damage to the FM-28. Check supply voltage before connecting power cord!

The FM-28 is supplied ready to operate from any regulated 13.8V DC, 7.0 ampere negative ground source. An automobile, 12 volt, negative ground, system is usually more than adequate. Some note must be taken, however, to the condition of the vehicle's electrical system. Problems such as low battery, worn generator/alternator, poor voltage regulator, etc., will impair operation of your FM-28 as well as the vehicle.

It is recommended that the DC power cable supplied with the FM-28 be wired directly to the vehicle battery terminals. Be certain to observe correct polarity; RED wire is POSITIVE (+) and BLACK wire is NEGATIVE (–). Do not attempt to install the FM-28 in a vehicle employing POSITIVE GROUND ignition system.

Where temporary mobile installation is made and it is not practical to wire directly to the vehicle battery operation is possible in some vehicles by employing such expediencies as a cigar lighter adapter. However, less than full performance of the FM-28 will likely be attained, particularly in the HI PWR transmit mode.

In selecting a base station power supply it is imperative that the unit be sufficiently regulated so that its no load voltage not exceed 15.8 volts and voltage at 7 amps load not drop below 13 volts. Output hum and ripple should be less than 100 millivolts.

The Clegg Model 060 is ideally suited as an economical, reliable station supply for the FM-28.

3.4 Antenna:

The most important single item that will influence the performance of any communication system is the antenna. For that reason, a good, high-quality antenna of 50 ohms impedance is recommended. When adjusting your antenna, whether mobile or fixed, by all means follow the manufacturer's instructions. There are some pitfalls to be aware of. For example, do not attempt to adjust an antenna for lowest VSWR when using a VSWR meter not engineered for VHF applications. Such readings will invariably have a substantial at 144 MGz. Rather, use an in line meter similar to the Drake WV—4 or Bird Model 23 with VHF cartridge. Further, when adjusting a mobile antenna, do so with the motor running preferably above normal idling speed. This will insure proper voltage level to the transceiver.

Do not become alarmed if your transceiver fails to transmit at times during the antenna tune up procedure. Remember, your transceiver has a built-in Automatic Protection Circuit (APC) that will disable the transmitter if excessive VSWR, or an open or shorted coaxial line or connector, or other antenna deficiency is present.

The RF coaxial connector on the rear chassis mates with a standard PL—259 connector.

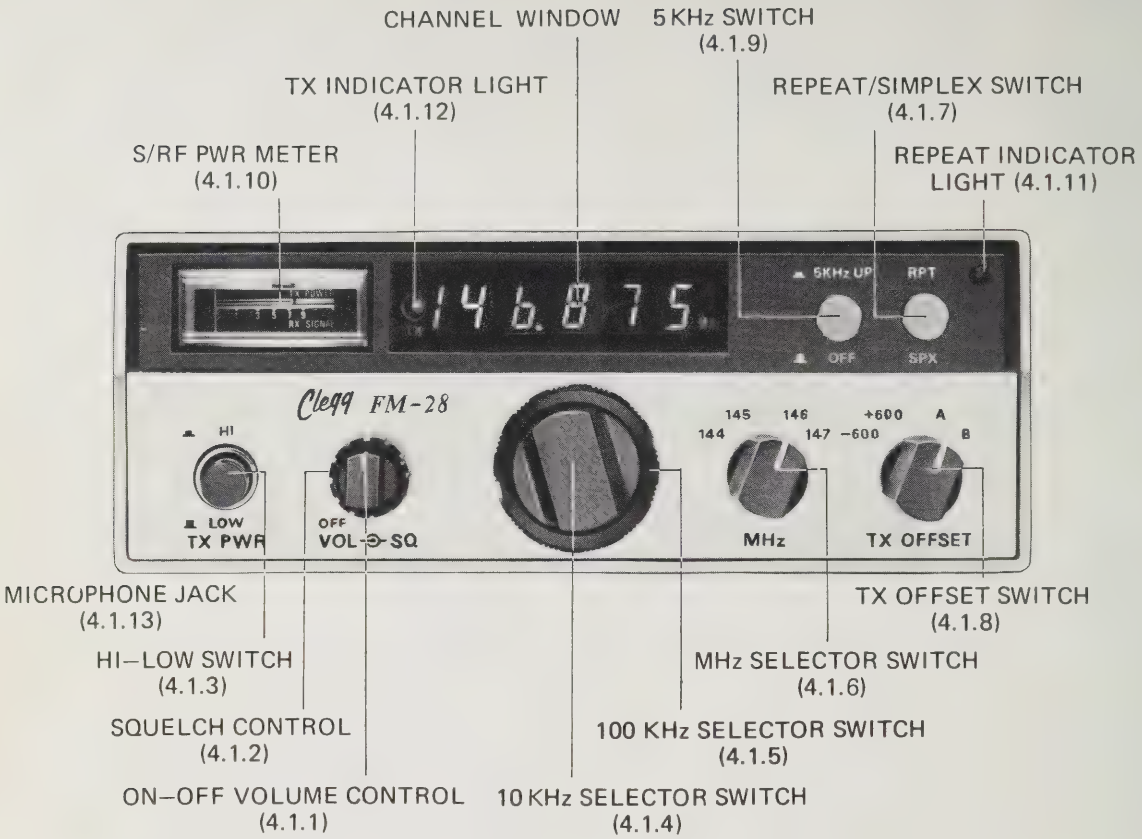
CLEGG COMMUNICATIONS stocks a substantial line of 2 meter antennas and beams. Our sales department will be pleased to advise you as to the best choice for your specific application.

3.5 Microphone:

A high quality dynamic microphone is supplied with your transceiver. Merely plug it into the proper receptable on the front panel. Should you with to use a different microphone, make certain it is of the low impedance type (600 ohms). Particular care should be exercised in wiring as the internal electronic switching system is dependant upon it. See the schematic for the proper hook up. Under no circumstances use a "gain pre-amp" type microphone. The audio system in your transceiver is more than adequate and additional pre-amplification is unnecessary. To use this class of microphone is to invite distortion and unsatisfactory operation of the transceiver.

SECTION 4. CONTROL FUNCTIONS

4.1 FRONT PANEL CONTROLS



4.1.1 **ON–OFF/VOLUME CONTROL:** Applies power to receiver and adjusts desired level of sound

4.1.2 **SQUELCH CONTROL:** Silences background noise in the absence of a received signal when properly adjusted. Rotation in clockwise direction increases SQUELCH threshold.

4.1.3 **TX PWR SWITCH:**

"LOW" position : transmitter operates at 1 watt output level.
"HIGH" position : transmitter operates at full power output.

4.1.4 **10 KHz SELECTOR SWITCH:** The inner switch selects the desired frequency in 10 KHz increments from 0 to 9 and simultaneously activates LED display on the channel window.

4.1.5 **100 KHz SELECTOR SWITCH:** The outer switch selects the desired frequency in 100 KHz increments from 0 to 9 and simultaneously activates LED display on the channel window.

4.1.6 **MHZ SELECTOR SWITCH:** This four position rotary switch selects the desired frequency in 1 MHz increments from 144 to 147 and simultaneously activates LED display on the channel window.
Note that the digits "14" are fixed and back-lighted when the power is "ON".

4.1.7 RPT/SPX SWITCH

RPT position: Activates TX OFFSET function for displacing transmitter output frequency from receiver frequency for Repeater access and operation. Also activates REPEAT INDICATOR LIGHT.

SPX position: Disables OFFSET function and places both transmitter and receiver on identical frequencies.

4.1.8 **TX OFFSET SWITCH:** This control selects the frequency difference between the displayed receiver frequency and the transmitter output frequency. (Typically –600 KHz for repeaters below 147 MHz and +600 KHz for repeaters above 147 MHz). To accomodate non-standard repeaters positions A and B can be used by installation of appropriate offset crystals available from Clegg.

4.1.9 **5 KHz SWITCH:** This switch increases operating frequency by 5 KHz and simultaneously activates 6th digit in LED display on the channel window.

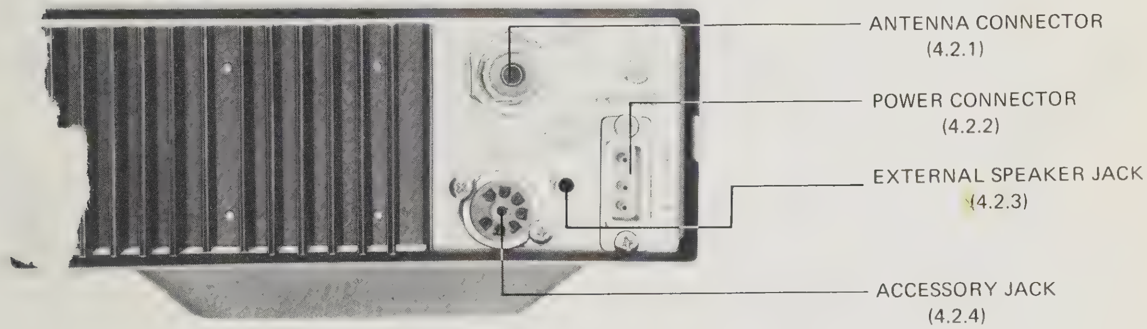
4.1.10 **S/RF PWR METER:** Shows signal strength of the received signal and relative transmitter RF output power.

4.1.11 **REPEAT INDICATOR LIGHT:** Lights brightly when RPT/SPX switch is in RPT mode.

4.1.12 **TX INDICATOR LIGHT:** Lights brightly when transmitting.

4.1.13 **MICROPHONE JACK:** Accepts 4 prong mike plug supplied on microphone.

.2 REAR PANEL CONTROLS



4.2.1 **ANTENNA CONNECTOR:** Accepts standard PL–259 coaxial connector

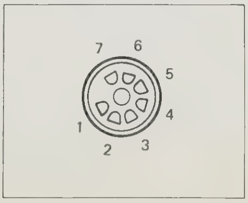
4.2.2 **POWER CONNECTOR:** Accepts polarized power cord for 13.8V Supply.

4.2.3 **EXTERNAL SPEAKER JACK:** This jack mates with the accessory Ext. speaker plug supplied for external 8 ohm speaker on headset use. The use of this jack will disable the internal speaker.

4.2.4 **ACCESSORY JACK:**

Accepts 7 pin plug for interconnecting various accessory devices to the transceiver.

1.Tone Input
2. Keyed DC, High on TX
3. Unkeyed DC
4. Remote PTT control
5. TIE POINT (DO NOT USE)
6. Discriminator Meter
7. Ground



SECTION 5. OPERATING INSTRUCTIONS

5.1 INITIAL PREPARATIONS

5.1.1 Connect the microphone to the microphone jack

5.1.2 Connect the antenna to the antenna coax connector. Make sure the coax line is of the correct impedance (50 ohms) and is neither shorted nor open circuited.

5.1.3 Make sure the volume control is in the off position and the squelch control is in the maximum counterclockwise position. The red lead should be connected to the positive side of the power source and the black lead to the negative side. If these leads are improperly connected, the FM-28 will not function. No damage will be incurred since protection is provided in the FM-28 for this purpose.

5.2 OPERATION

5.2.1 Rotate the volume control clockwise a few degrees until the switch snaps into the ON position, and LED frequency display on the channel window and S/RF meter will be illuminated.

5.2.2 Adjust MHz. 100 KHz and 10 KHz selector switches to the desired frequency.

5.3 RECEIVER

5.3.1 Advance the volume control to the desired audio level.

5.3.2 Carefully adjust the squelch control clockwise until the audio noise just disappears. This is the proper squelch threshold setting and must be done when no signal is present. Your transceiver will now remain silent until an incoming signal is received which opens the squelch. If the squelch is unstable due to the reception of a weak or unstable station, adjust the squelch control further until the proper threshold is obtained.

5.3.3 The S meter indicates the signal strength of the incoming stations and is calibrated in S units. An input signal of approximately 5 μV will provide an S9 reading.

5.4 TRANSMITTER

The operation of the transmitter and receiver is controlled by the push-to-talk switch located on the side of the microphone. When depressed, the transmitter is placed into operation and, at the same time, the receiver becomes inoperative.

5.4.1 Place the REPEAT/SIMPLEX switch in either the REPEAT or SIMPLEX position. In the REPEAT position, TX OFFSET switch is activated and REPEAT INDICATOR LIGHT illuminates. In the –600 position on TX OFFSET switch, the transceiver transmits at the frequency of –600 KHz than Receiver frequency and in the –600 position, the transceiver transmits at the frequency of +600 KHz. Position A and B provide capability to use the FM-28 with non-standard repeater pairs. Consult Clegg Sales Dept.

5.4.2 Place the HI–LOW power switch in either the HI or LOW position dependent on the range of desired communications. In the HI position, the transceiver operates at full 25 watt output. In the LOW position, the transceiver operates at one watt of power. (The HI–LOW power switch can be set to the LOW power position and the power output can be adjusted between .1 and 4 watts by means of internal potentiometer RT–552 accessible with bottom cover removal).

5.4.3 When pushing the PTT (push to talk) button on the microphone, the TX INDICATOR LIGHT is illuminated and the METER provides an indication of relative power output of the transmitter. The pointer will be on or near the red mark on the meter scale when on high power and just a little over 1 on low power when the the antenna SWR is acceptably low.

NOTE: Do not attempt to transmit unless your antenna is properly connected.

SECTION 6. CIRCUIT DESCRIPTION

6.1 RECEIVER CIRCUIT

6.1.1 **RF Unit:** Signal from the antenna connector passes through the dual-tuned band pass filter, and is amplified by Q101, and fed into FT101 a 3-section helical resonator. The signal is then mixed with signal from the VCO unit by Q102 first mixer, and produces first IF 16.9MHz.

6.1.2 **IF Unit:** Signal from the RF unit passes through FT151 4-Pole monolythic crystal filter, and is amplified by Q151 first IF AMP., and is mixed with signal from Q153, 16.445 MHz. Second IF passes through FT152 ceramic filter, and is limited in amplification by IC151 and 152. The AF signal is detected by FT153 ceramic discriminator, and fed into the AF unit.

6.1.3 **AF Unit:** AF signal from the IF unit is amplified by Q203 and IC202, and drives the speaker, while noise signal from the IF unit is amplified by IC201 and Q201, and detected by D201 and D202, and drives switching transistor. Q202 controls Q203 AF amplifier and activates squelch.

6.2 TRANSMITTER CIRCUIT

6.2.1 **Tx Driver Stage Unit:** Signal from the VCO and Signal which is selected from X701 to X705 and oscillated by Q706 in IF unit are mixed with balanced mixer Q401 and Q402, and produce mixer output in the 146 MHz band. That signal is then amplified by Q403, Q404 and Q405, and drives the final unit.

6.2.2 **Final Unit:** Output from the transmit driver unit amplified by Q451, Q452 and Q453 into a 25 watt output which is supplied into the APC unit. Signal from the final unit passes through the SWR Bridge, diode switch D503 and D504, and also passes through 3-section low pass filter, and produces 25 watt output which is supplied into the APC unit.

6.3 PHASE LOCKED LOOP CIRCUIT

6.3.1 **Local Unit:** Crystals X251 and X252 are selected by switching transistors Q251 and Q252, and are oscillated by Q253. Oscillation output is multiplied three times by Q254, and again multiplied three time by Q255, and then it is fed into PLL mixer Q256. Simultaneously fed into Q256 is the output of VCO unit, and PLL IF (4.000–5.995 MHz) is produced.

6.3.2 **Counter Unit:** The PLL IF is amplified by Q304 generated by Q303 and fed into IC304. This signal is divided in half by IC304. It is then program-divided by 301, to produce an output of 25 KHz. On the other hand, X301(10.24 MHz) is oscillated by Q306, and fed into IC304 through driver Q305. Here again, the signal frequency is divided in half by IC304, and fed into IC301, where the output of 1/1024 (5 KHz) is produced.

6.3.3 **VCO Unit:** The difference output from the counter unit passes through the active low pass filter (Q351 through Q353), and goes into the VCO D351, D352 and Q354, and controls the VCO frequency. The output of the VCO is amplified by Q356, and fed into the local unit PLL mixer Q256. On the other nand, the output of the VCO is also amplified by Q355, which produces the local frequency for both transmit and receive.

6.3.4 **Display Unit:** The desired BCD code is selected by the channel selector, and decoded by IC651 through IC653, and it drives the LED display.

6.4 POWER SUPPLY CIRCUIT

DC input from the power connector is regulated by Q551 through Q553, and 13.6V DC is selected for transmit and receive. Q557 and Q558 are worked as protector circuit. When the excessive power happens to be supplied in transmit or receive, Q558 is automatically cut off and protects the circuits from the damage. IC801 is used for a 5V regulator for the TTL and C-MOS. Q554, Q555 and Q801 regulate the final unit as high-low power controller. D553, D554 and Q556 are activated by APC unit, and unlock signal of the counter unit, and regulate Q555 to shut down the transmit power.

SECTION 7. ALIGNMENT PROCEDURE

7.1 GENERAL

THE FM-28 HAS BEEN FACTORY ALIGNED USING TECHNIQUES AND TEST EQUIPMENTS NOT NORMALLY AVAILABLE TO THE SERVICE TECNICIAN. IT SHOULD NOT BE NECESSARY TO PERFORM ANY ALIGNMENT ON THE UNIT AS RECEIVED FROM THE FACTORY. IN THE EVENT OF COMPONENT FAILURE, ANY REALIGNMENT WILL BE MINIMAL. IF IT APPEARS THAT ANY LARGE DEGREE OF REALIGNMENT IS REQUIRED, THOROUGHLY CHECK THE REPLACEMENT COMPONENT BEFORE PROCEEDING.

7.2 PHASE LOCKED LOOP CIRCUIT

7.2.1 Equipment Required:

a) 13.8V DC Power Source (3A).
b) Synchroscope (DC to more than 150 MHz)
c) Frequency Counter (More than 150 MHz)

7.2.2 Set up:

a) Initial front panel controls should be set in the following manner.

* POWER SWITCH (OFF—Volume) : Off
* 10KHz & 100KHz SELECTOR SWITCH : Any position
* BAND MHz SELECTOR SWITCH : Any position
* 5 KHz SWITCH : Either position
* REPEAT-SIMPLEX SWITCH : Simplex
* TX OFFSET SWITCH : Any position
* HI-LOW SWITCH : Either position

b) Connect the power cable to the 13.8V DC power source.

c) In the VCO unit.

c—1) Remove the wire of either J353 or J303

c—2) Remove the connector plug of J352 and connect to Synchroscope using coaxial cable with 2-P connector to be fitted to the terminals. 6 (HOT) and 7 (GROUND).

c—3) Connect VTVM and 200K ohm variable resistor to TP351 as described below:

7.2.3 Proceudre:

a) Apply power to the unit.

b) Adjust 200K ohm variable resistor connected to TP351 for 5.5 Volt VTVM reading and L352 for 131.1 MHz ± 0.2 MHz frequency counter reading.

c) Adjust 200 K ohm variable resistor for 129.1 MHz ± 0.2 MHz frequency counter reading and L354 for maximum synchroscope amplitude.

d) Remove the connector from J352 6 and 7 and reconnect it to J352 4 and 5. Then, adjust L353 for maximum.

e) Connect TP251 to 10 : 1 probe of synchroscope and adjust L253 and 254 for maximum synchroscope amplitude, and adjust them so as to be within 20% of amplitude difference when 145 and 146 MHz bands are alternately switched.

f) As for TP-252, adjust L255 and 256, the same to above.

g) Conduct frequency adjustment in the following manner:

1) Connect frequency counter to the plug (P401) of J401.

2) Measure and adjust frequency on following channels.
* 144.005 MHz: f = 127.105 MHz. CT254
* 144.000 MHz: f = 127.100 MHz. CT251
* 147.005 MHz: f = 130.105 MHz. CT253
* 147.000 MHz: f = 147.000 MHz. CT252

NOTE: Repeat the procedures 144.005 MHz, 144.000 MHz and 147.005 MHz, 147.990 MHz.

7.3 RECEIVER

7.3.1 Equipment Required:

a) 13.8V DC Power Source (3A)
b) VHF Sweep generator and all accessories
c) Signal generator (144—148 MHz)
d) AF measurement equipments —4 ohm dummy load
V.T.V.M.
Oscilloscope
Distortion Meter
Audio Oscillator
e) DC Volt Meter

7.3.2 Set-up:

a) Initial front panel controls should be set in the following manner:
* POWER SWITCH (Off-volume) : Off
* SQUELCH CONTROL : Fully counterclockwise
* OTHER SWITCHES : Any position

b) Connect the power cable to the 13.8V DC power source.

c) Connect all of AF measurement equipments (See 7.3.1 — d) to external speaker jack.

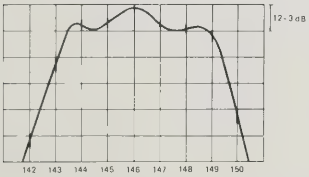
d) Detach J351 in VCO unit.

e) Connect 'scope vertical to case of Q102

f) Connect RF cable from sweep generator to ANT connector and adjust to 146 MHz center freq. with about 12 MHz sweep width.

7.3.3 Procedure:

a) Apply power to the unit and turn on power switch.
b) Adjust L101, L102 and FT101 to obtain a wave form as illustrated below on the following measurement conditions.



* Input level . . . . 5.6 mV rms
* Marker . . . . Increment by 1 MHz
* Center frequency . . . . 146 MHz
* Oscilloscope . . . . x 1 range (max.)

c) Then, detach the sweep generator and remove the cable from the case of Q102 in RF unit, and connect the signal generator (146.00 MHz, 3.3 KHz deviation at AF 1 KHz) to the antenna terminal and replace J351 in VCO unit. Set MHz, 100 KHz and 10 KHz controls to 146.00.

d) Increase the output level of the signal generator for one third reading of indicator on the S-Meter scale and adjust L103, L104, L151 and L152 several times for the peak power.

e) Adjust the signal generator for the 5 μV input and adjust RT152 to make the meter read 59.

f) Adjust RT151 for convenient SQUELCH control range.

7.4 TRANSMITTER

7.4.1 Equipment Required:

a) 13.8V DC power source (8A)
b) RF power meter (Bird Watt Meter 50W 150 MHz)
c) Frequency Counter (More than 150 MHz)
d) FM Linear detector
e) AF distortion meter
f) VTVM
g) AF oscillator
h) Spectrum analyzer (1.2G Hz)
i) Microphone or TX Switch
j) DC volt meter
k) Feed through dummy load (more than 30 watts)
l) RF attenuator

7.4.2 Set-up:

a) Initial front panel controls should be set in the following manner:

* POWER SWITCH (OFF-volume)	:	Off
* HI—LOW SWITCH	:	HI Position
* RPT/SPX SWITCH	:	SPX
* OTHER SWITCHES	:	Any position

b) Connect the power cable to the 13.8V DC power source.

c) Connect the power meter to the antenna terminal.

d) Connect the FM linear detector and the frequency counter.

e) Connect the TX switch, the AF oscillator and the VTVM to the microphone connector (Mike connector pin No. 1 — Audio, 2 & 3 — Ground, 4 — PTT.).

7.4.3 Procedure:

a) Before the power switch is on, make the preliminary adjustment as follows :

a—1) Adjust L401 through L407 so that the core enters about 1.2mm below the can.

a—2) Turn the semi-fixed resistors as follows:

RT551 and RT553	:	Fully clockwise
RT351 and RT552	:	Fully counterclockwise
RT401	:	Middle position

a—3) Set the trimmer CT401, CT402, CT451, CT452, CT453; CT454 and CT501 at the position of half capacitance.

b) Turn on the power switch and set the channel to the 146.00 MHz.

c) Keep the unit in TX with the microphone or the TX switch and adjust L401 through L406 for the maximum voltage at the TP401.

d) Adjust L407, CT401 and CT402 for the maximum reading on the 13.8V DC power source meter.

e) Adjust CT451, CT452 and CT453 for the maximum reading on the RF power meter.

f) Repeat the above step c) through e) adjustments repeatedly.

g) Feed the output power of feed through dummy load to the spectrum analyzer through the RF attenuator.

h) Connect J502 (APC output in APC unit) to the DC volt meter.

i) Repeat the following adjustments several times respectively, at **146.00 SX**

   i–1) Adjust RT551 for 27 watts on RF power meter

   i–2) Adjust CT501 and RT501 for the minimum swing on DC volt meter

   i–3) Adjust CT452 CT453 and CT454 for the maximum power on the RF power meter.

   i–4) Adjust RT502 for the middle reading of Red mark on P/S meter of the unit.

j) Adjust CT701 and set the frequency to the 146.00 MHz.

k) Press the RPT/SPX switch and set the TX OFFSET switch to the 600 position, and adjust CT702 for the 145.400 MHz.

l) Set the TX OFFSET switch to the +600 position and adjust CT703 for the 146.600 MHz.

m) Set in the HI–LOW switch to the low position and adjust RT551 for 1.5W on RF power meter.

n) Feed AF 1 KHz 100mV from the microphone connector and adjust RT 351 for 5 KHz on FM linear detector.

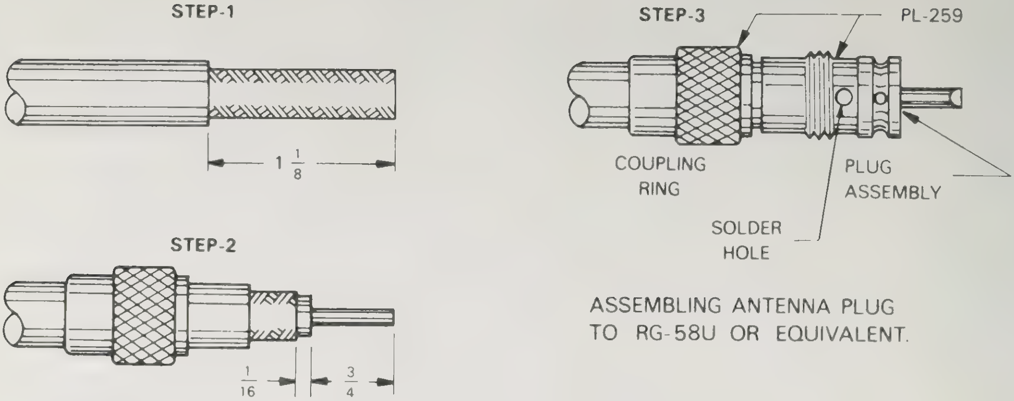
o) Feed the AF signal to the pin No.1 and 7 (Ground) in the accessory jack and check the modulation is activated.

p) Remove the RF power meter from the antenna connector and adjust RT553 for 2.5 amperes on the 13.6V DC power source meter.

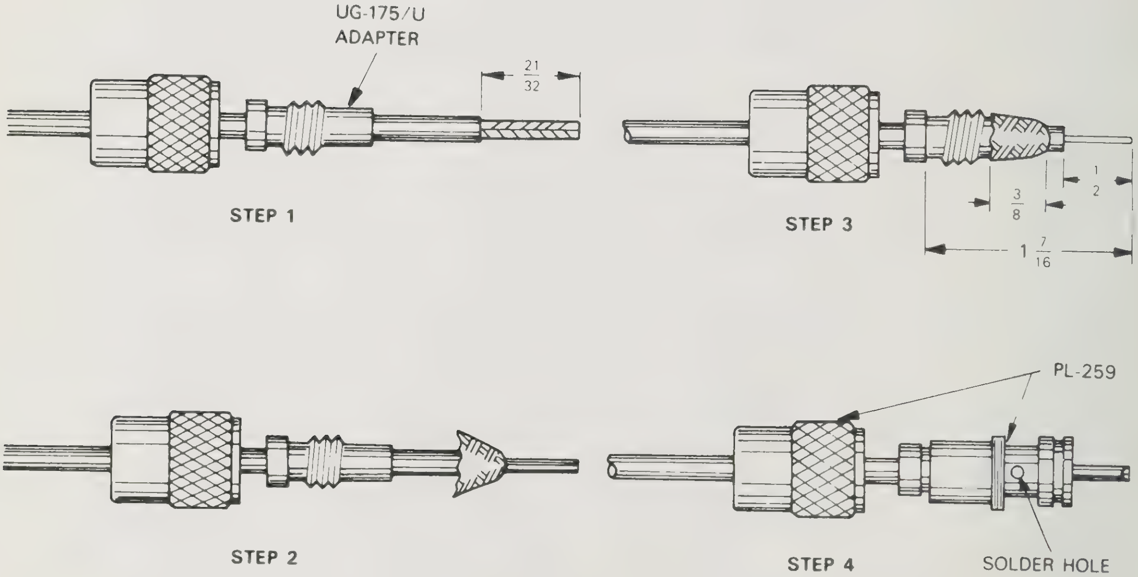
q) Again connect the RF power meter to the antenna connector and just adjust CT454 to minimize the power difference during 144 to 147.900 MHz.

r) Observe that under all operating conditions spectrum Analyzer indicates no spurious outputs in excess of –60 dB referenced to desired output.

COAXIAL CONNECTOR ASSEMBLY DETAIL

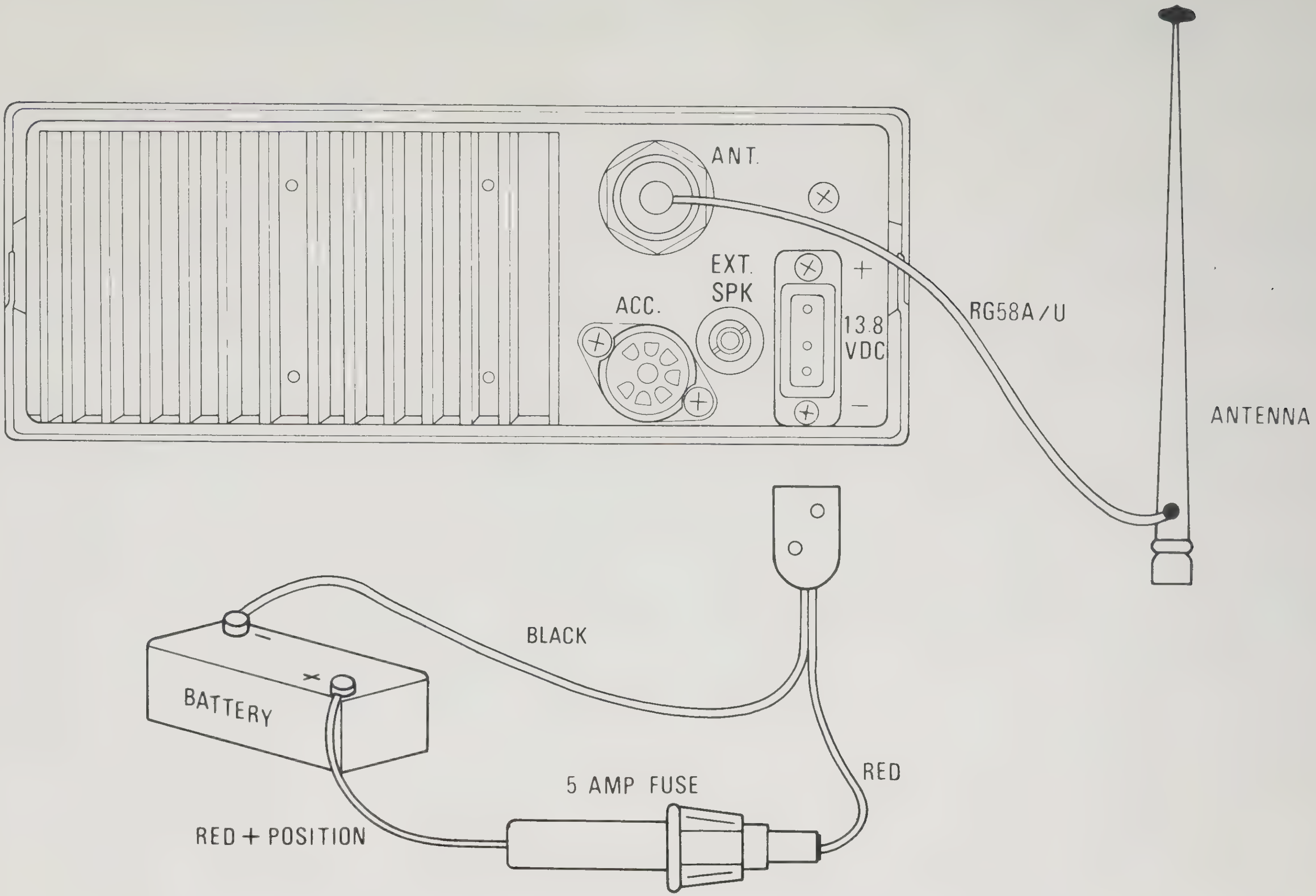


ASSEMBLING ANTENNA PLUG
TO RG-58U OR EQUIVALENT.



ASSEMBLING ANTENNA PLUG TO RG-58U
OR OTHER ¼″ COAXIAL CABLE

INSTALLATION DIAGRAM

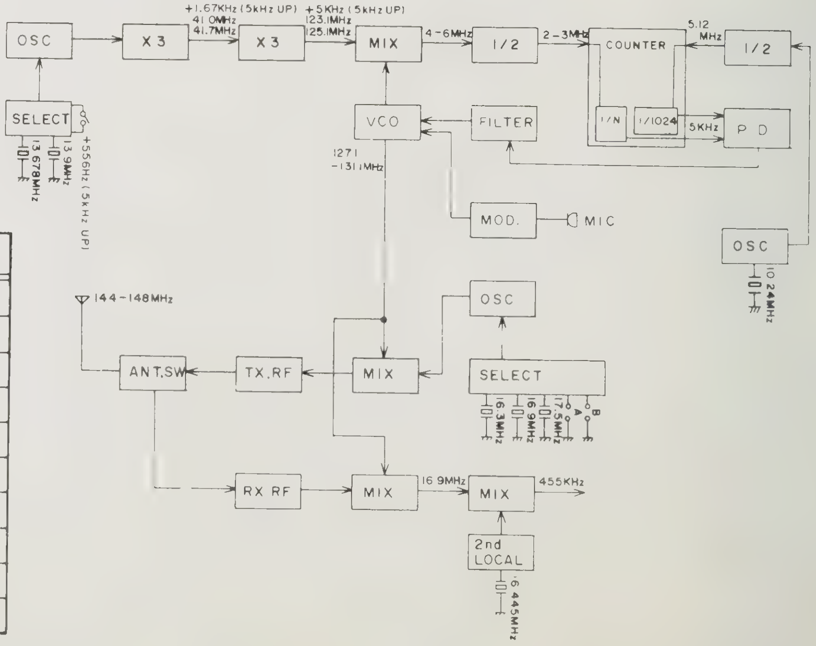


FREQUENCY CHART

Channel Designator	Local Crystal Frequency	PLL IF Frequency	Divided & BCD CODE Ratio [N]	Out put Frequency
14[A] . [B] [C]				
A=4 or 5	13.67778	[A] . [B] [C] MHz	[A] [B] [C]	14[A] . [B] [C] MHz −16.9MHz
A=6 or 7	13.90000	do.	do.	do.
14[A] . [B] [C] 5				
A=4 or 5	13.67833	do.	do.	do.
A=6 or 7	13.90056	do.	do.	do.

Channel Designator		Local Crystal Frequency		PLL IF Frequency	Divided Ratio [N]	Out put Frequency	
	+5K		+5K				+5K
144.00 ≀ 144.99	5	13.67778	+556Hz	4.000 ≀ 4.990	400 ≀ 499	127.100 ≀ 128.090	+5KHz
145.00 ≀ 145.99				5.000 ≀ 5.990	500 ≀ 599	128.100 ≀ 129.090	
146.00 ≀ 146.99		13.90000		4.000 ≀ 4.990	400 ≀ 499	129.100 ≀ 130.090	
147.00 ≀ 147.99				5.000 ≀ 5.990	500 ≀ 500	130.100 ≀ 131.090	

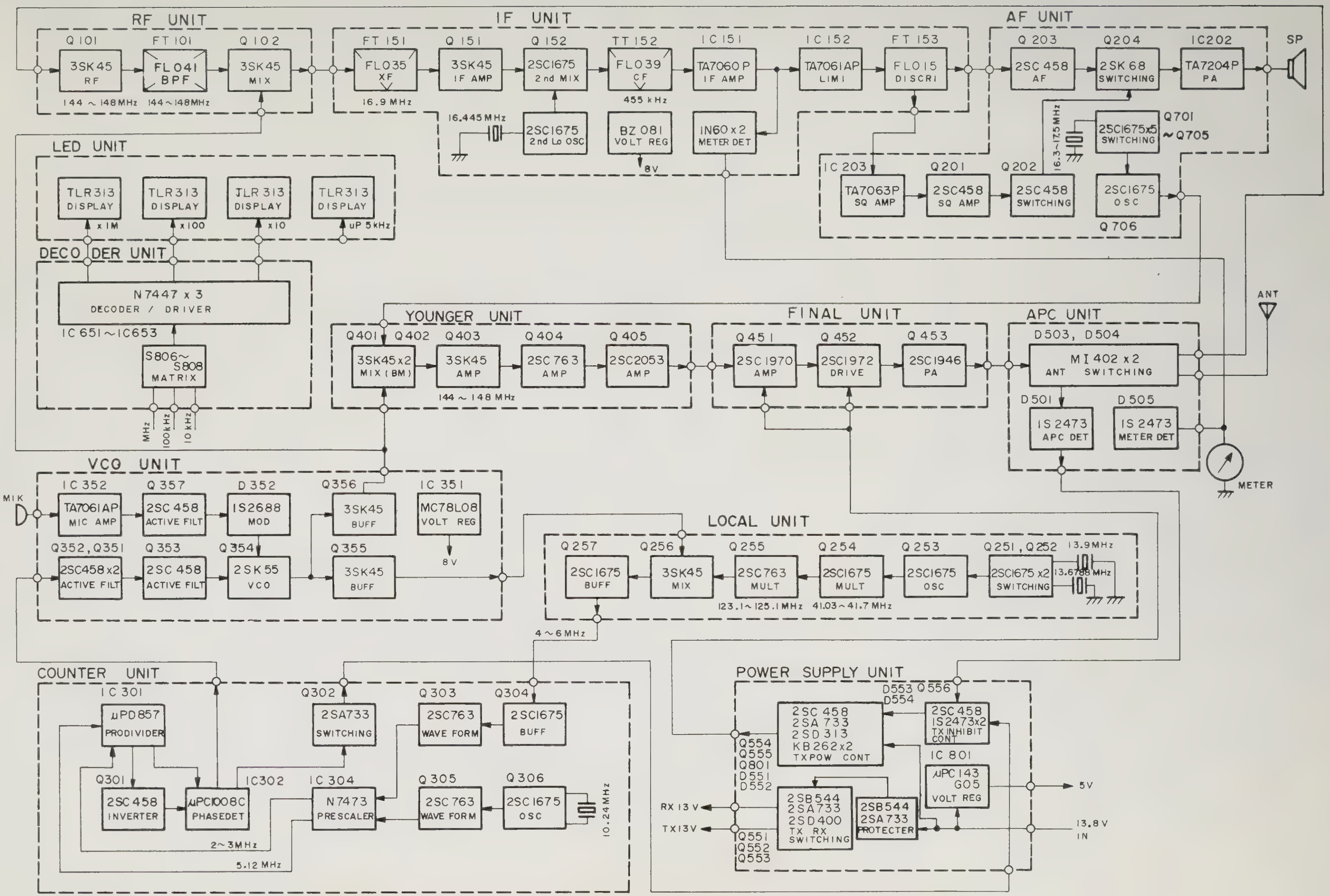
*Frequencies are in MHz.



BCD CODE

	A	B	C	D
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

BLOCK DIAGRAM



VOLTAGE CHART

Note.
1. Measured at 146.00 MHz.
2. Measured by DC voltmeter 50K ohm/V,
3. B; Base, E;Emitter, C; Collector, G; Gate, S; Source, D; Drain.

Dual Gate MOS –FET

#	Name	G1	G2	S	D	Remarks
Q101	3SK45-B	0	3.9	0.3	12.8	
102	do	0	0	0.2	12.3	
151	do	0.7	1.8	0.8	6.0	
256	do	0	0	0.3	5.5	
355	do	0	3.1	0	6.2	
356	do	0	3.1	0.7	6.7	
401	do	0	0	0.3	12.0	
402	do	0	0	0.3	12.0	
403	do	0	4.3	0	11.8	

Bipolar Transistor & J–FET

#	Name	B/G	E/S	C/D	Remarks
Q152	2SC1675-L	1.9	1.3	11.5	
153	do	3.0	2.7	6.6	
201	2SC458-C	1.0	0.5	5.5	
202	do	0 (0.6)	0 (0)	1.3 (0)	( ) : SQ Max.
203	do	1.3 (0)	0.7 (0)	4.4 (13.2)	( ) ; SQ Max.
		ç1.6´	ç5´	ç13.2´	ç ç ; TX.
253	2SC1675-L	3.5	3.3	7.3	
254	do	2.2	2.6	7.2	
257	2SC763-C	1.5	0.9	5.7	
301	2SC458-C	0.4	0	2.3	
302	2SA733-P	4.7	4.8	0	
303	2SC763-C	0.1	0	2.3	
304	2SC1675-L	1.4	0.9	1.8	
305	2SC763-C	0.1	0	2.4	
306	2SC1675-L	2.0	1.9	4.5	
351	2SC458-LGC	1.2	0.6	7.4	
352	do	0.6	0	4.1	
353	do	4.0	3.4	7.4	
354	2SK55-D	0	0.5	7.0	
357	2SC458-C	7.3	6.9	13.5	
404	2SC763-C	0.7	1.0	9.6	
405	2SC2053	-0.5	0	9.1	
451	2SC1970	-0.3 (-0.2)	0 (0)	11.2 (2.5)	( ) ; Low Power
452	2SC1972	0 (0)	0 (0)	11.2 (2.5)	do
453	2SC1946	0	0	12.7	
551	2SB544-E	13.5 (12.9)	13.5 (13.5)	0 (13.5)	( ) : TX
552	2SA733-P	12.9 (13.5)	13.5 (13.5)	13.5 (0)	do
553	2SD400-E	13.5 (0)	13.5 (0)	13.5 (13.5)	do

Bipolar Transistor & J-FET

#	Name	B/G	E/S	C/D	Remarks
557	2SA733-P	13.2	13.8	13.2	
558	2SB544-E	13.2	13.8	13.8	
706	2SC1675-L	6.0	5.6	13.5	

Bipolar Transistor

#	Name	B	E	C	Remarks
Q554	2SA733-P	12.9	13.8	13.8	Normal operating at Hi-power.
		13.8	13.8	3.3	Normal operating at Low-power.
		13.8	13.8	0	Controlled by APC or unlocked signal.
555	2SC458-C	5.8	5.3	13.2	Normal operating at Hi-power.
		1.0	0.6	13.8	Normal operating at Low-power.
		0	0	13.8	Controlled by APC or unlocked signal.
556	2SC458-C	0	0	5.8	Normal operating at Hi-power.
		0	0	1.0	Normal operating at Hi-power.
		0.6	0	0	Controlled by APC or unlocked signal.
801	2SD313-E	13.8	11.2	13.8	Normal operating at Hi-power.
		3.3	2.5	13.8	Normal operating at Low-power.
		0	0	13.8	Controlled by APC or unlocked signal.

Linier IC

#	Name	Pin number									
		#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
IC151	TA7060	1.4	1.4	0	7.6	7.4	–	–	–	–	–
152	TA7061AP	1.8	1.8	5.7	0	7.1	1.6	1.7	–	–	–
201	TA7063P	1.3	0.6	0.1	0	0.7	5.2	8.0	–	–	–
202	TA7204P	0	6.3	13.8	7.7	1.3	11.3	13.1	6.3	6.2	4.6
351	MC78L08CP	13.8	7.4	0	–	–	–	–	–	–	–
352	TA7061AP	1.9	1.9	11.4	0	11.2	1.9	1.9	–	–	–
801	μPC143G05	13.8	4.9	0	–	–	–	–	–	–	–

Digital IC

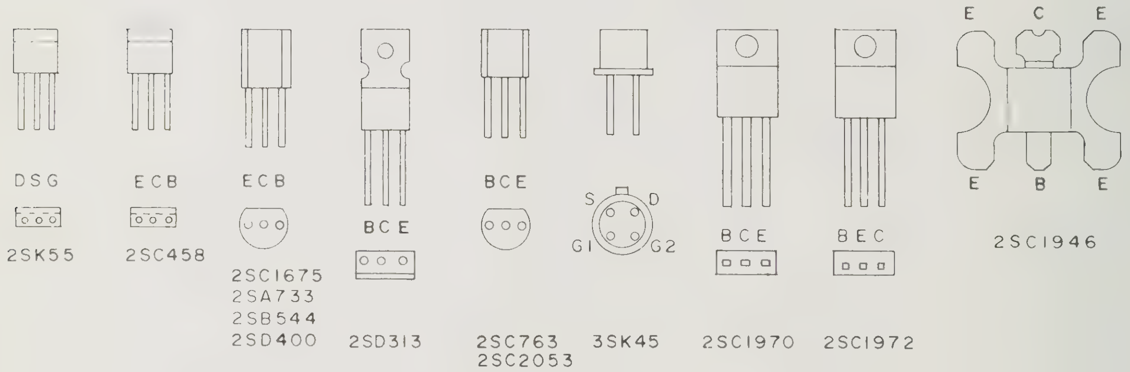
IC302 μPC1008C		IC303 N7473A		IC651 N7447A		IC652 N7447A		IC653 N7447A		IC301 μPD857CW	
Pin		Pin		Pin		Pin		Pin		Pin	
1	0.1	1	2.3	1	4.9	1	0.4	1	0.4	1	0.4
2	4.0	2	–	2	4.9	2	0.4	2	0.4	2	0.4
3	2.3	3	–	3	–	3	–	3	–	3	0.4
4	4.0	4	4.8	4	–	4	–	4	–	4	0.4
5	4.6	5	2.4	5	–	5	–	5	–	5	0.4
6	–	6	–	6	0	6	0.4	6	0.4	6	0.4
7	0	7	–	7	0.5	7	0.4	7	0.4	7	0.4
8	–	8	–	8	0	8	0	8	0	8	0.4
9	–	9	1.8	9	0.1	9	0.1	9	0.1	9	0
10	1.3	10	4.8	10	0.1	10	0.1	10	0.1	10	0
11	4.0	11	0	11	0.1	11	0.1	11	0.1	11	4.8
12	–	12	–	12	0.3	12	0.1	12	0.1	12	4.8

Digital IC

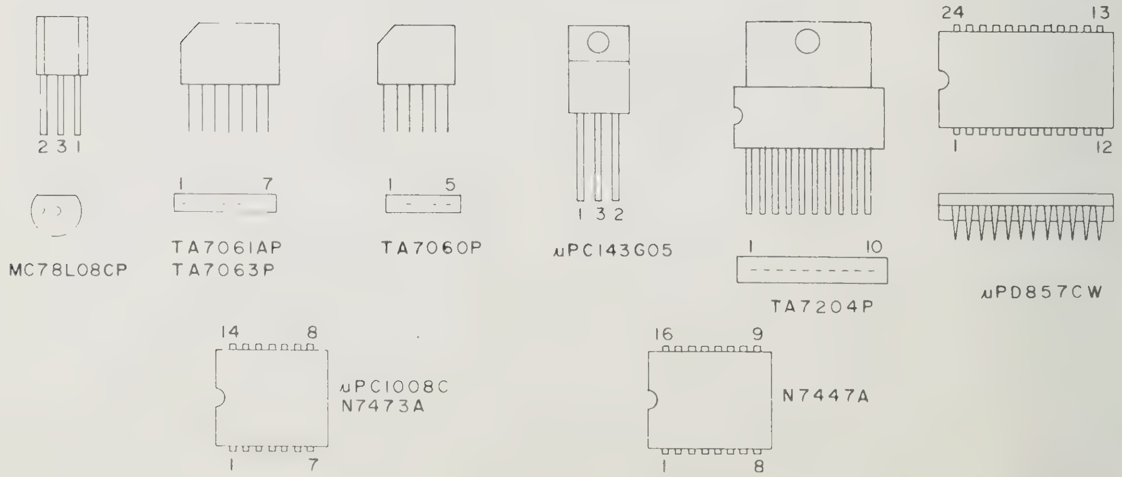
IC302 µPC1008C		IC303 N7473A		IC651 N7447A		IC652 N7447A		IC653 N7447A		IC301 µPD857CW	
Pin		Pin		Pin		Pin		Pin		Pin	
13	4.0	13	1.8	13	0.3	13	0.1	13	0.1	13	0.1
14	4.8	14	—	14	0.1	14	0.3	14	0.3	14	1.8
				15	0.1	15	0.1	15	0.1	15	0
				16	4.9	16	4.9	16	4.9	16	—
										17	—
										18	1.8
										19	2.1
										20	0
										21	—
										22	—
										23	0
										24	—

FET, TRANSISTOR & IC TERMINAL GUIDE

FET & TRANSISTOR CONNECTIONS

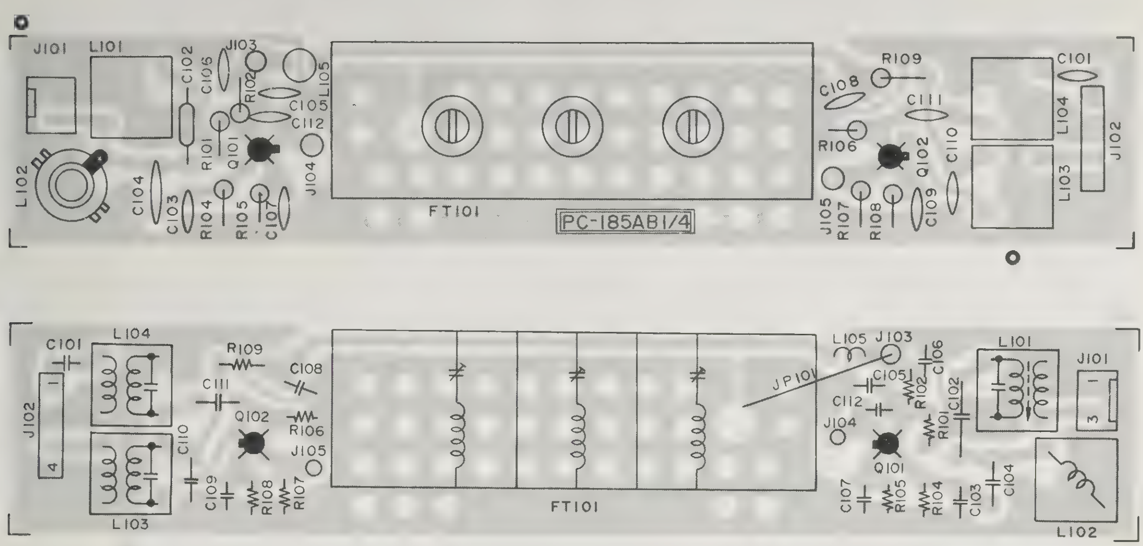


INTEGRATED CIRCUIT CONNECTIONS

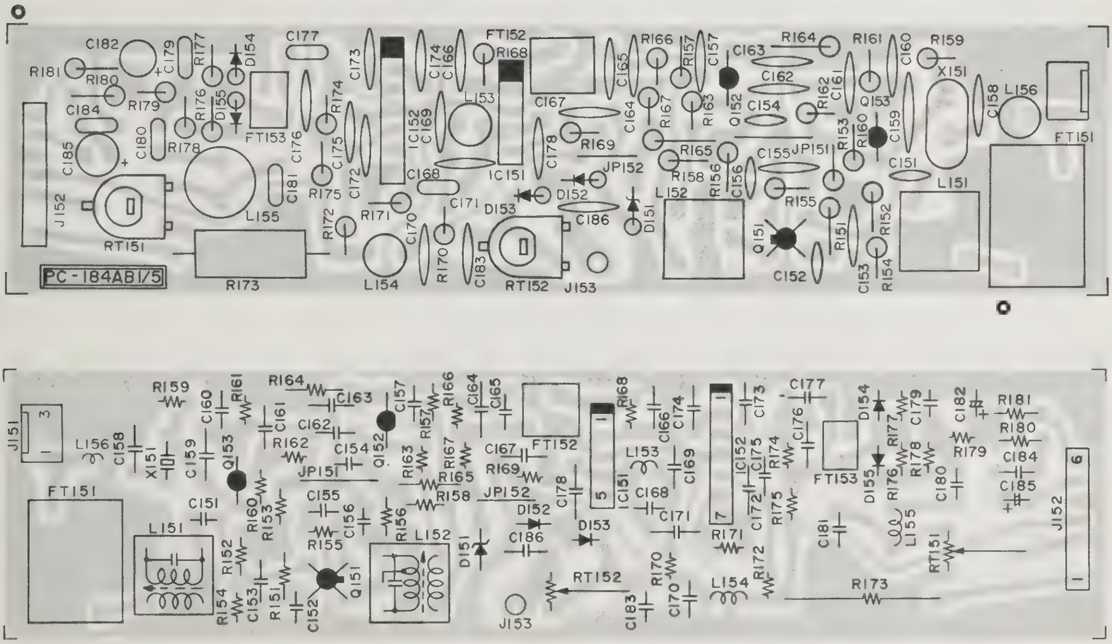


PRINTED CIRCUIT BOARD DETAIL

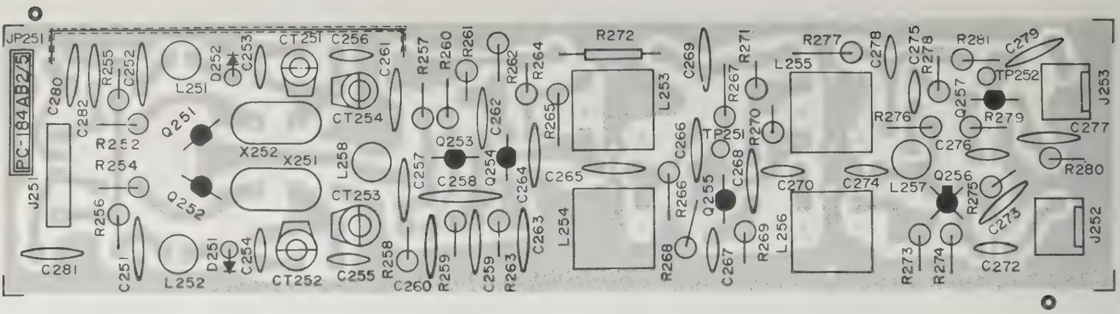
RF Unit PC – 185 1/4

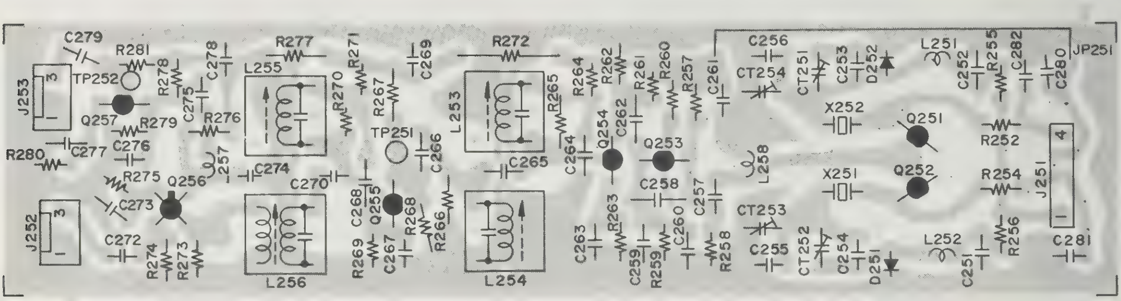


IF Unit PC – 184 1/5

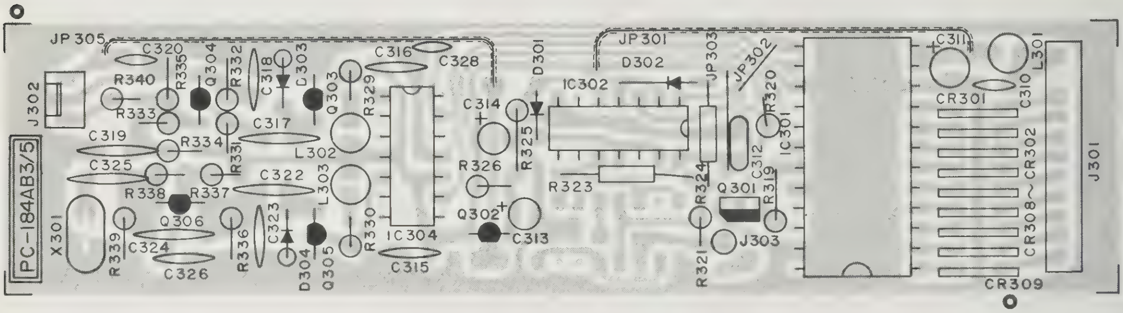


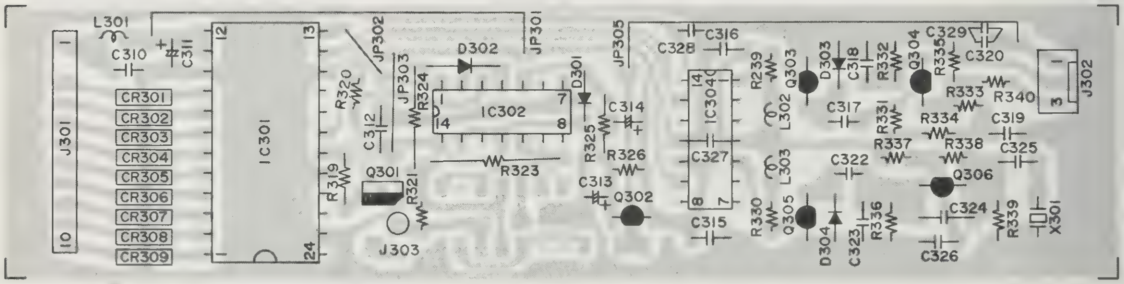
LOCAL Unit PC – 184 2/5



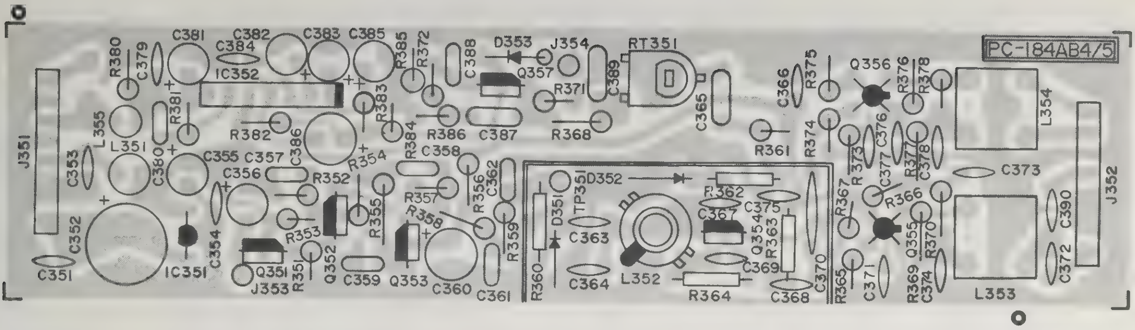


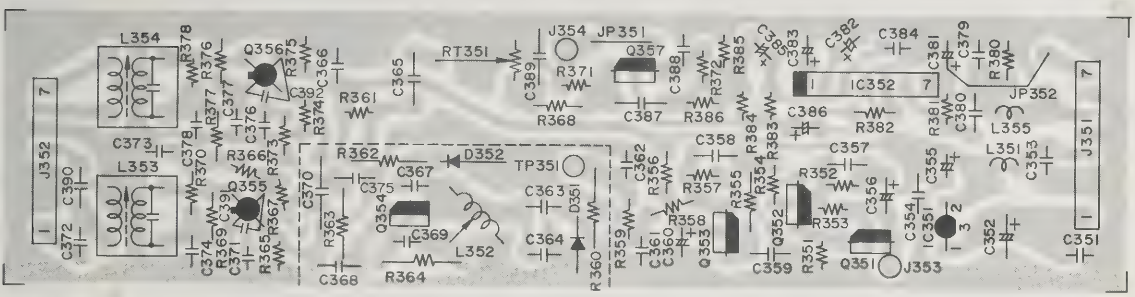
Counter Unit PC – 184 3/5



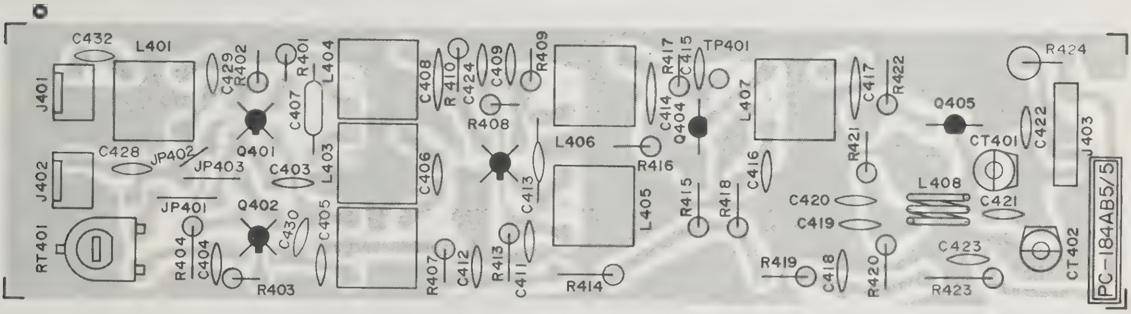


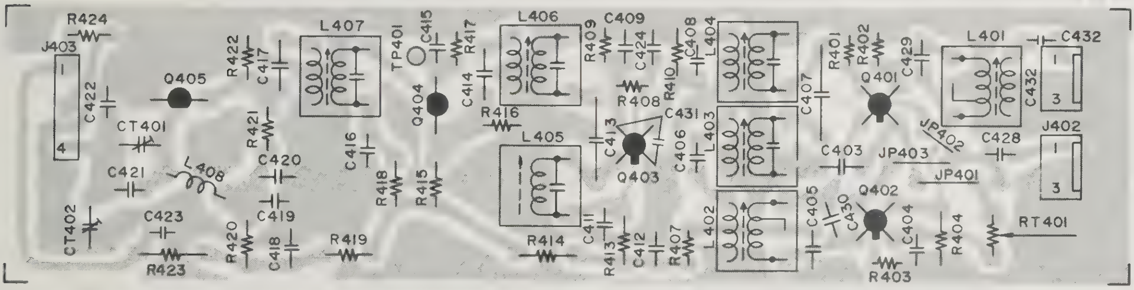
VCO Unit PC – 184 4/5



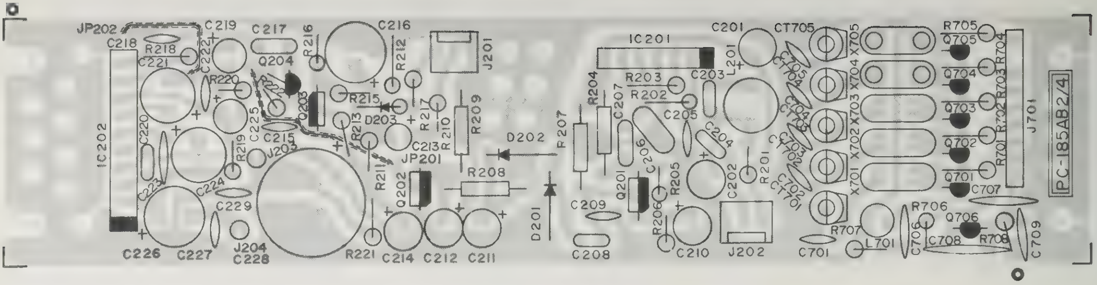


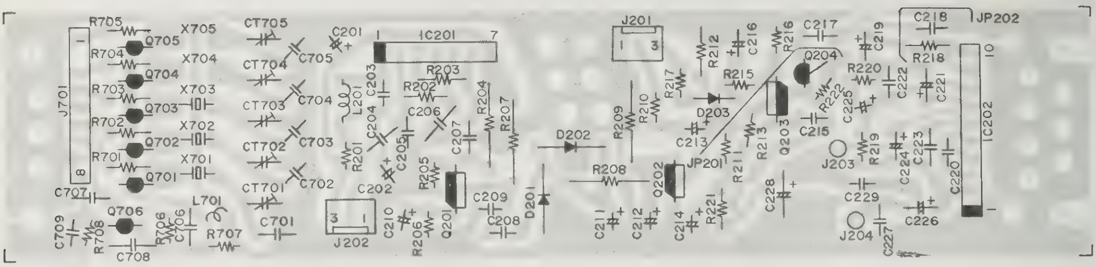
TX Driver Unit PC – 184 5/5



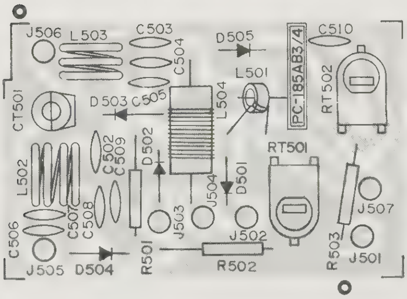


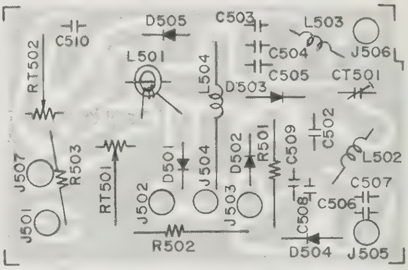
AF Unit PC – 185 2/4



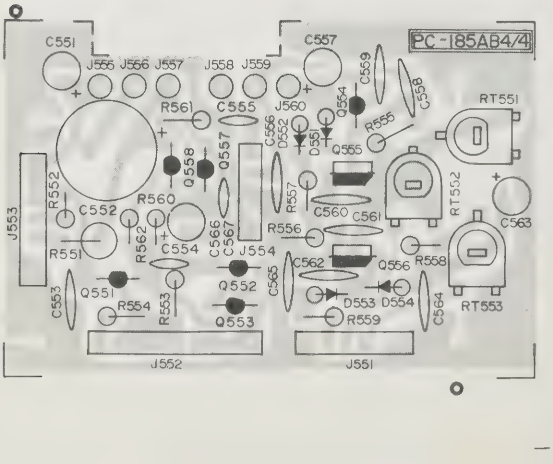


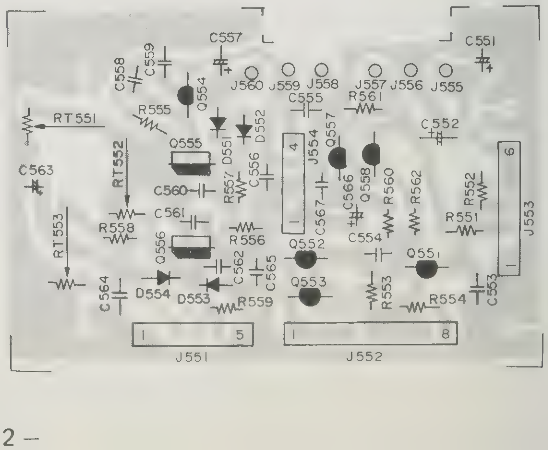
APC Unit PC – 185 3/4



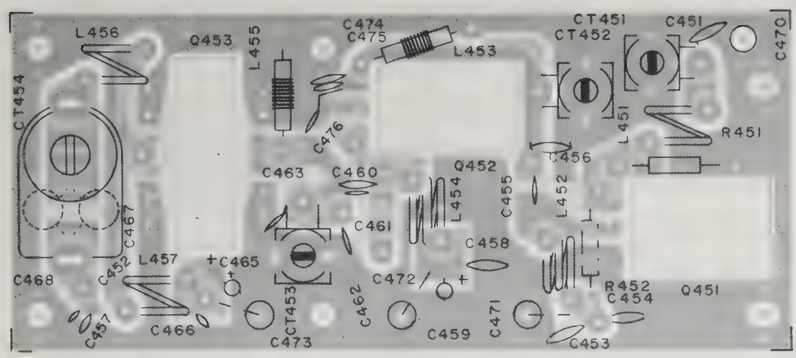


Power Supply Unit PC – 185 4/4

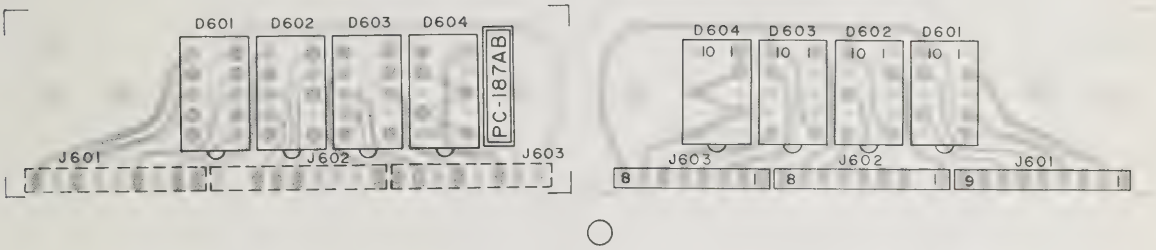




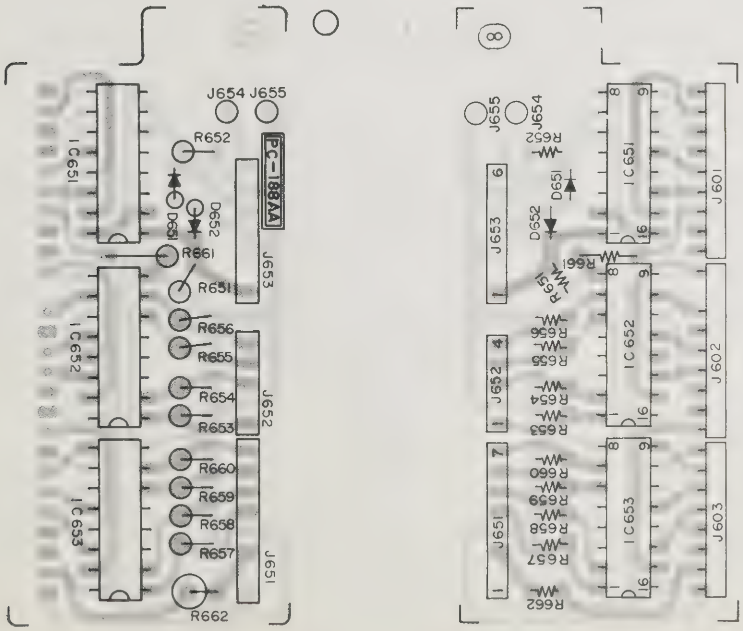
Final Unit PC – 186



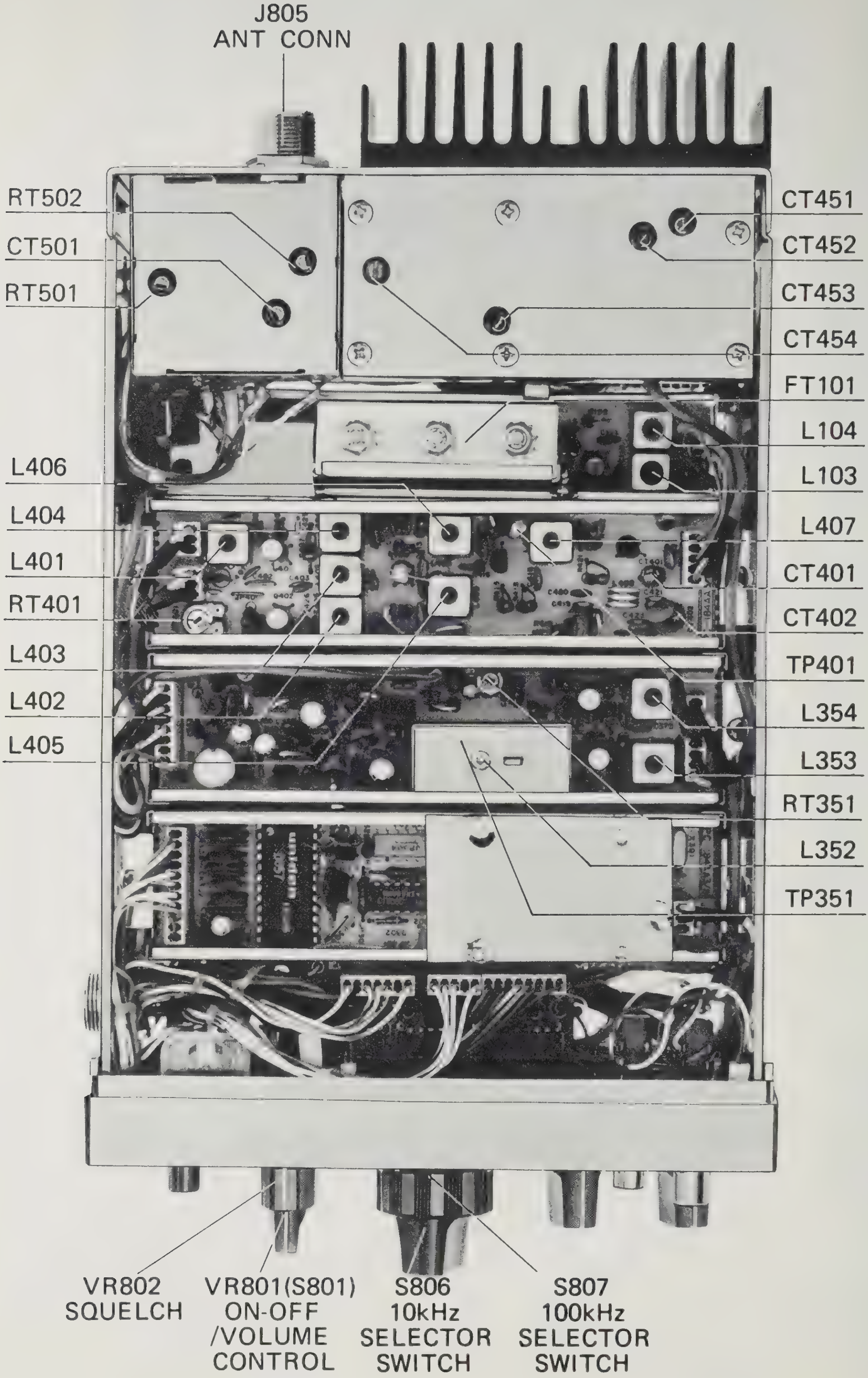
LED Unit PC – 187



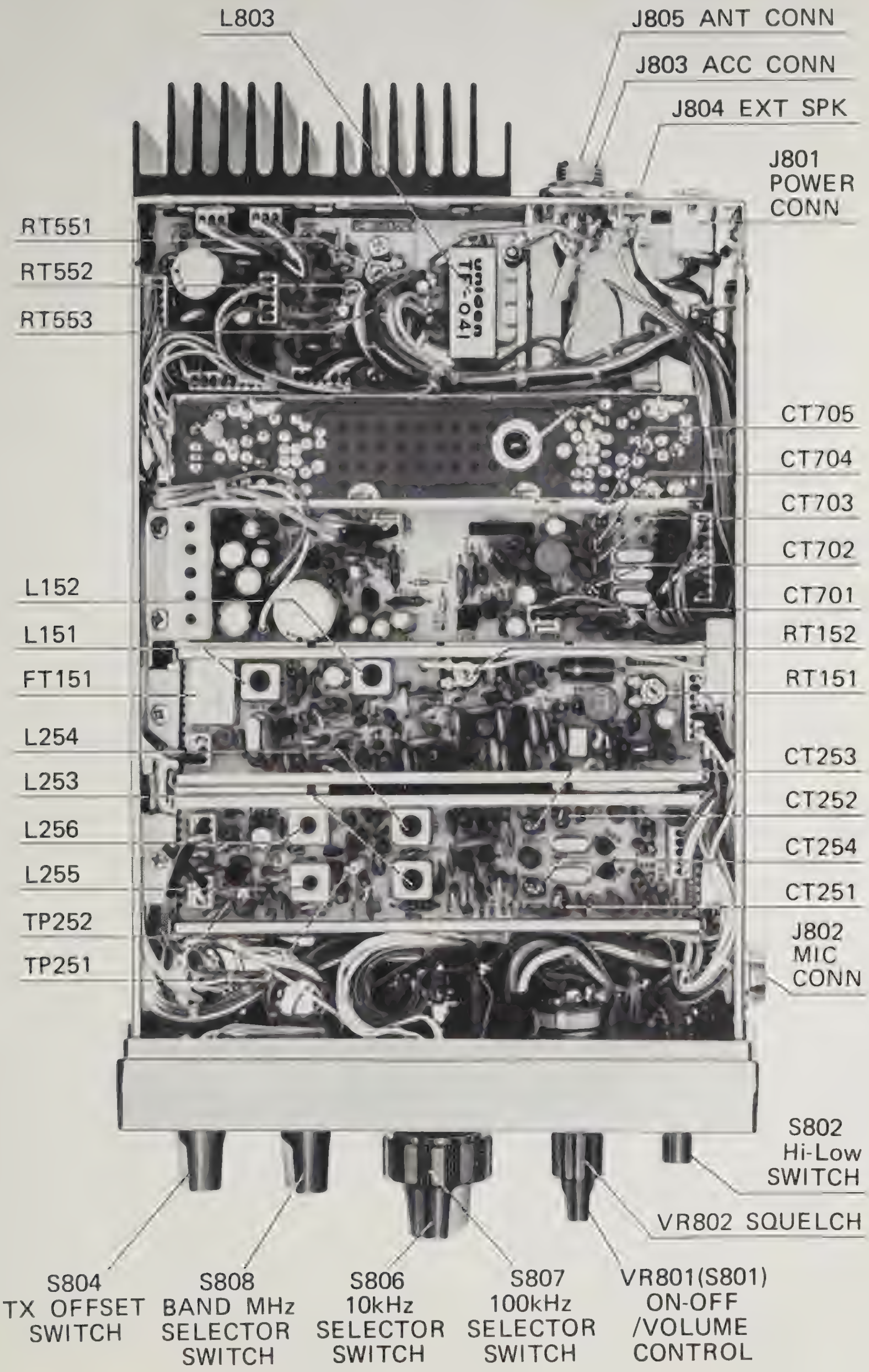
Decoder Unit PC – 188



TOP VIEW OF CHASSIS DETAIL

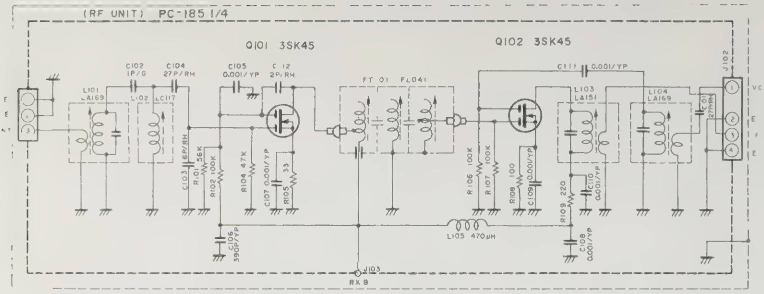


BOTTOM VIEW OF CHASSIS DETAIL

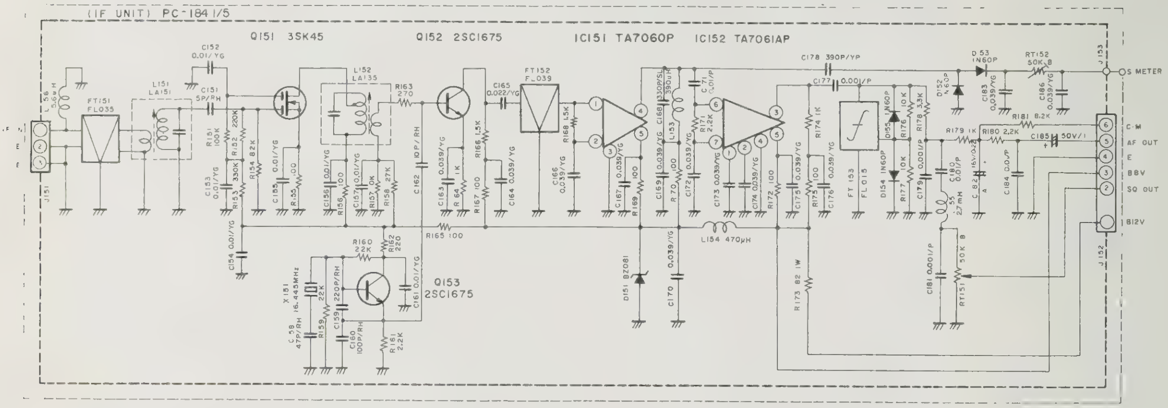


SCHEMATIC DIAGRAM (SEGMENT)

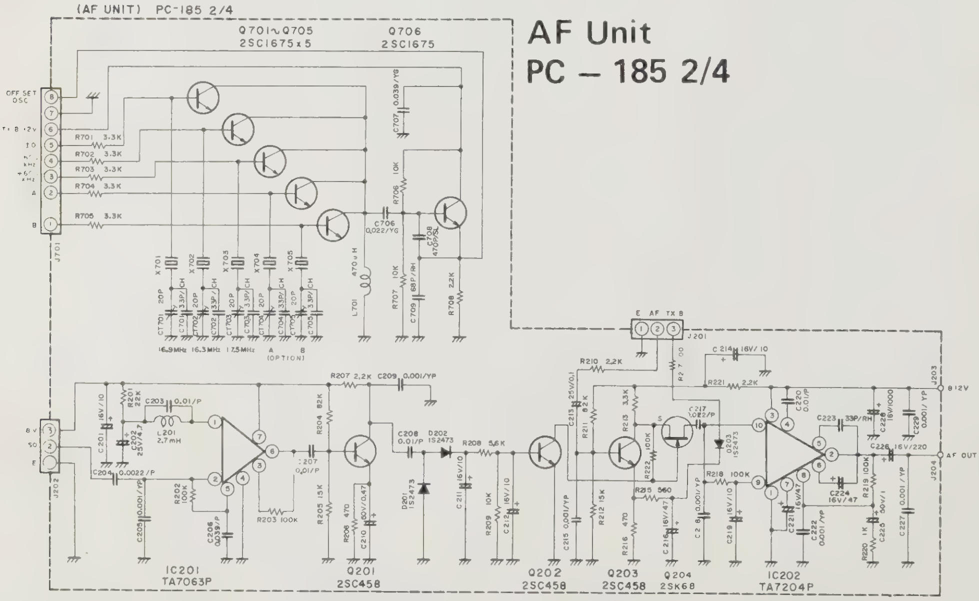
RF Unit PC – 185 1/4



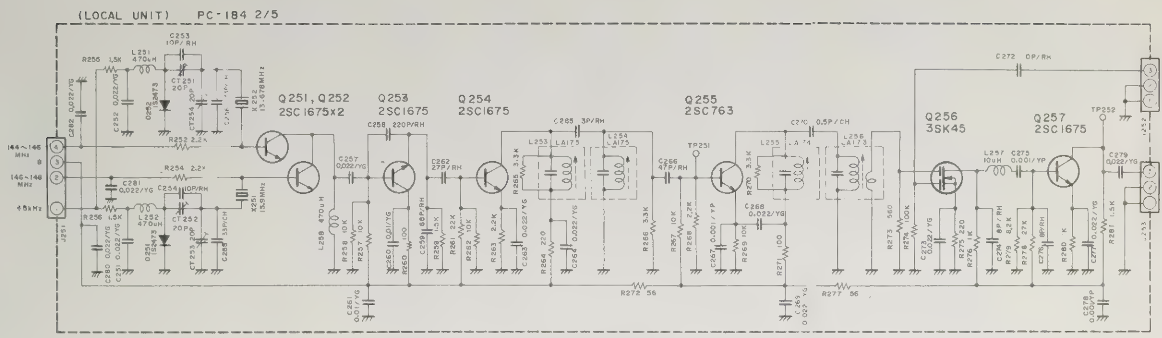
IF Unit PC – 184 1/5



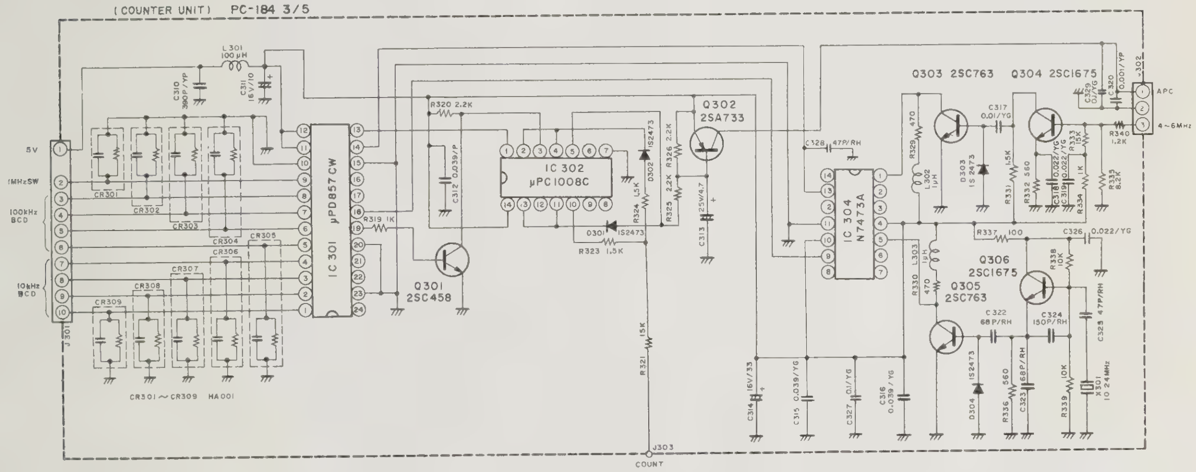
AF Unit
PC – 185 2/4



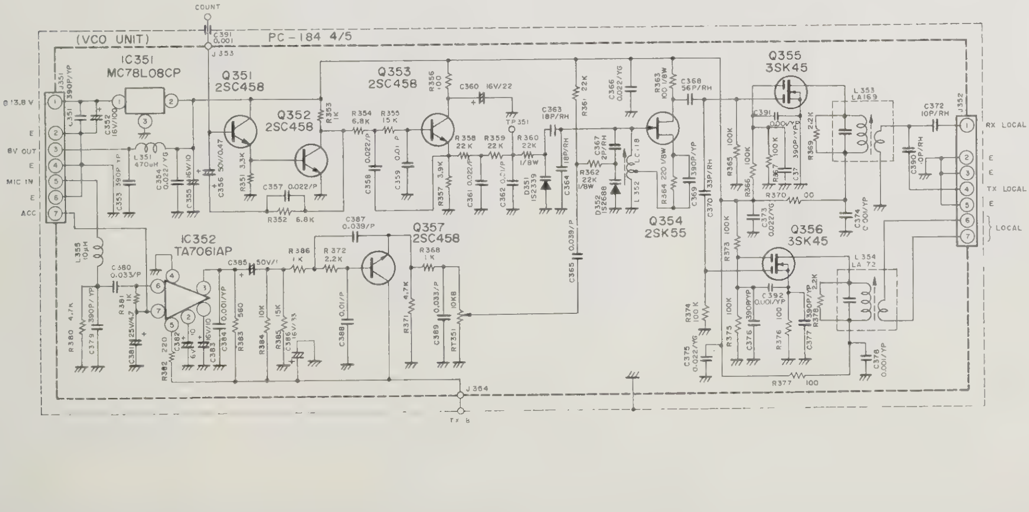
LOCAL Unit PC – 184 2/5



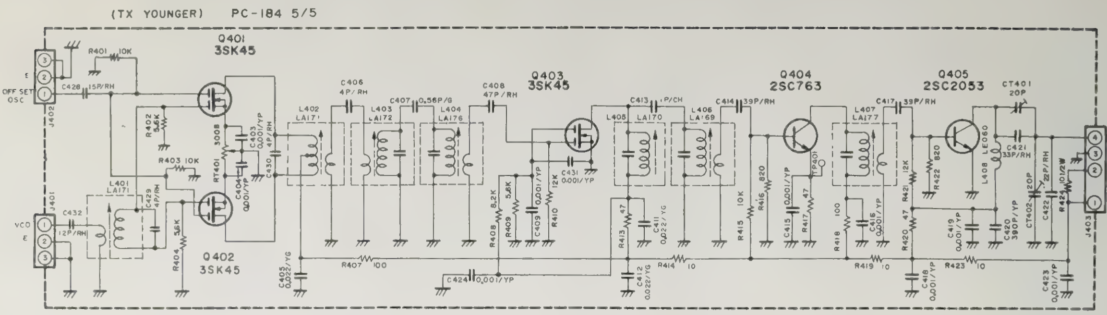
Counter Unit PC – 184 3/5



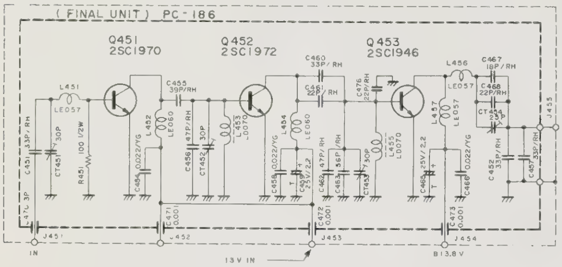
VCO Unit PC – 184 4/5



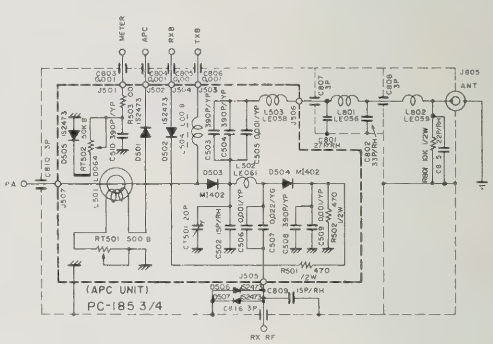
TX Driver Unit PC – 184 5/5



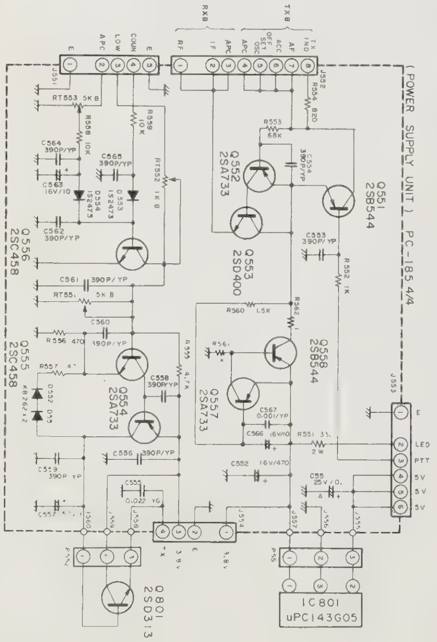
Final Unit PC – 186



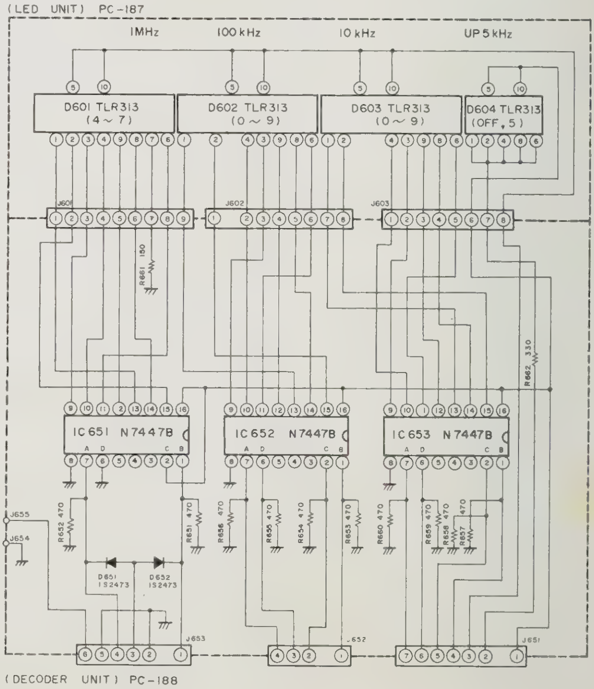
APC Unit PC – 185 3/4



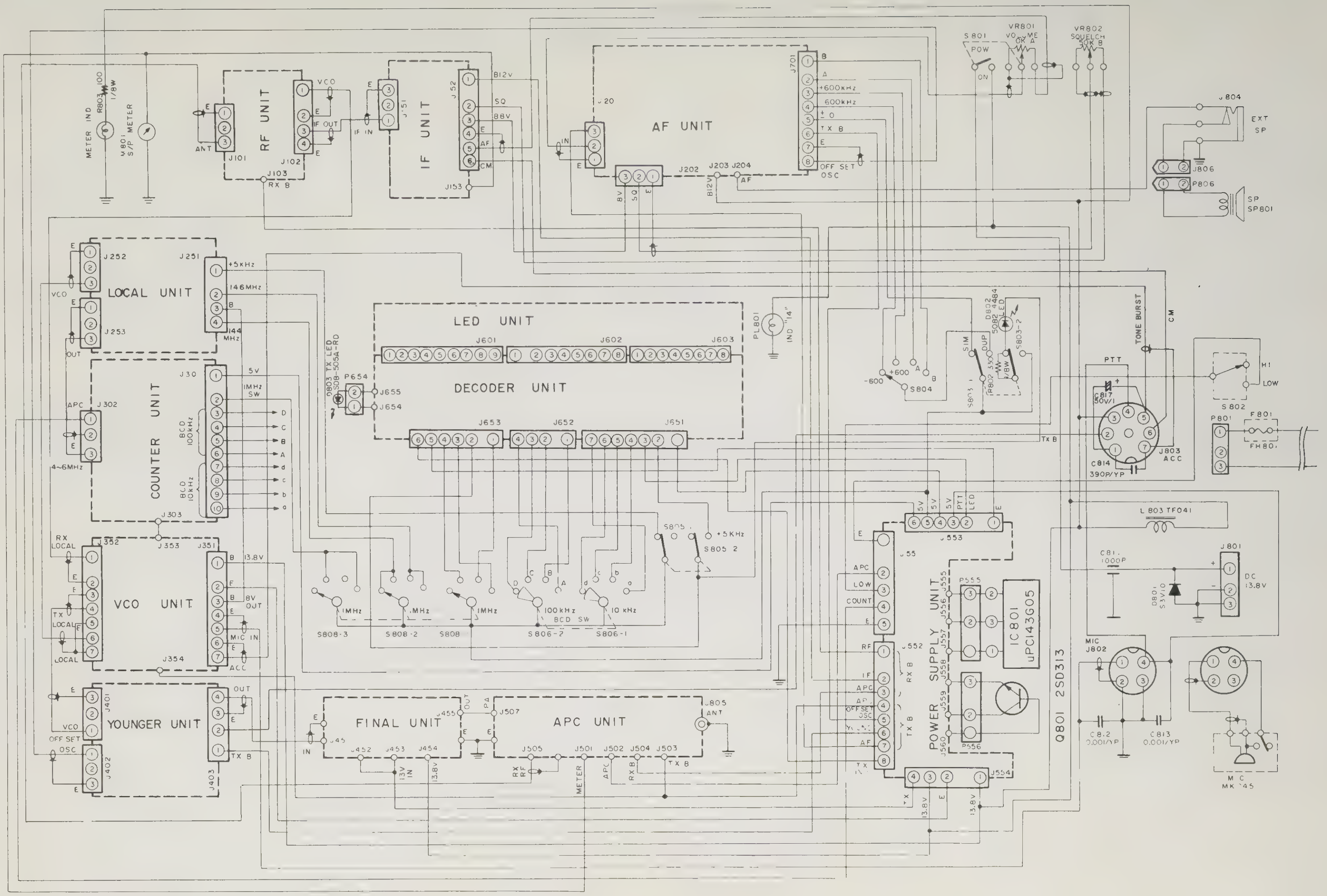
Power Supply Unit
PC – 185 4/4



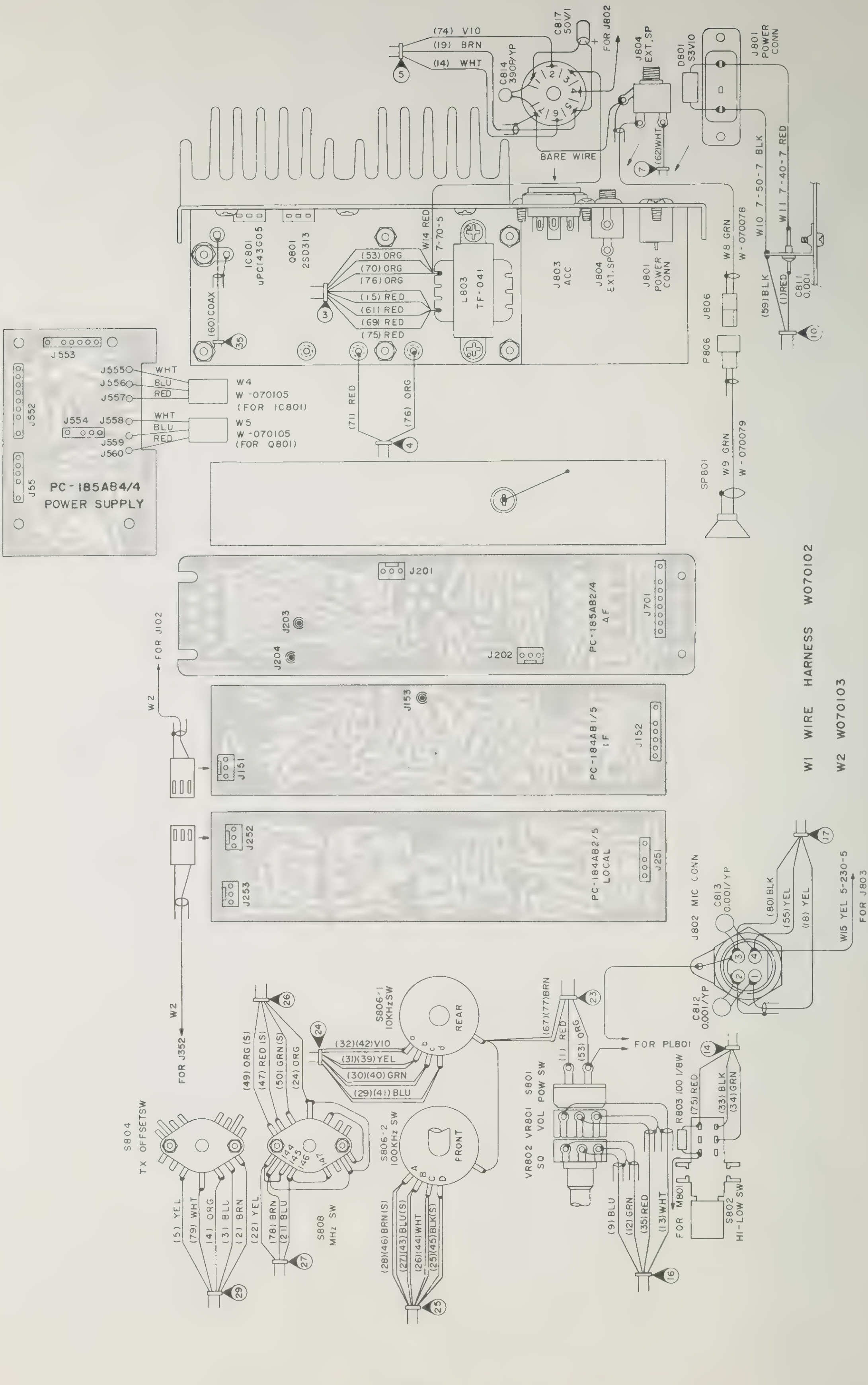
LED Unit PC – 187
Decoder Unit PC – 188



SCHEMATIC DIAGRAM (GENERAL)



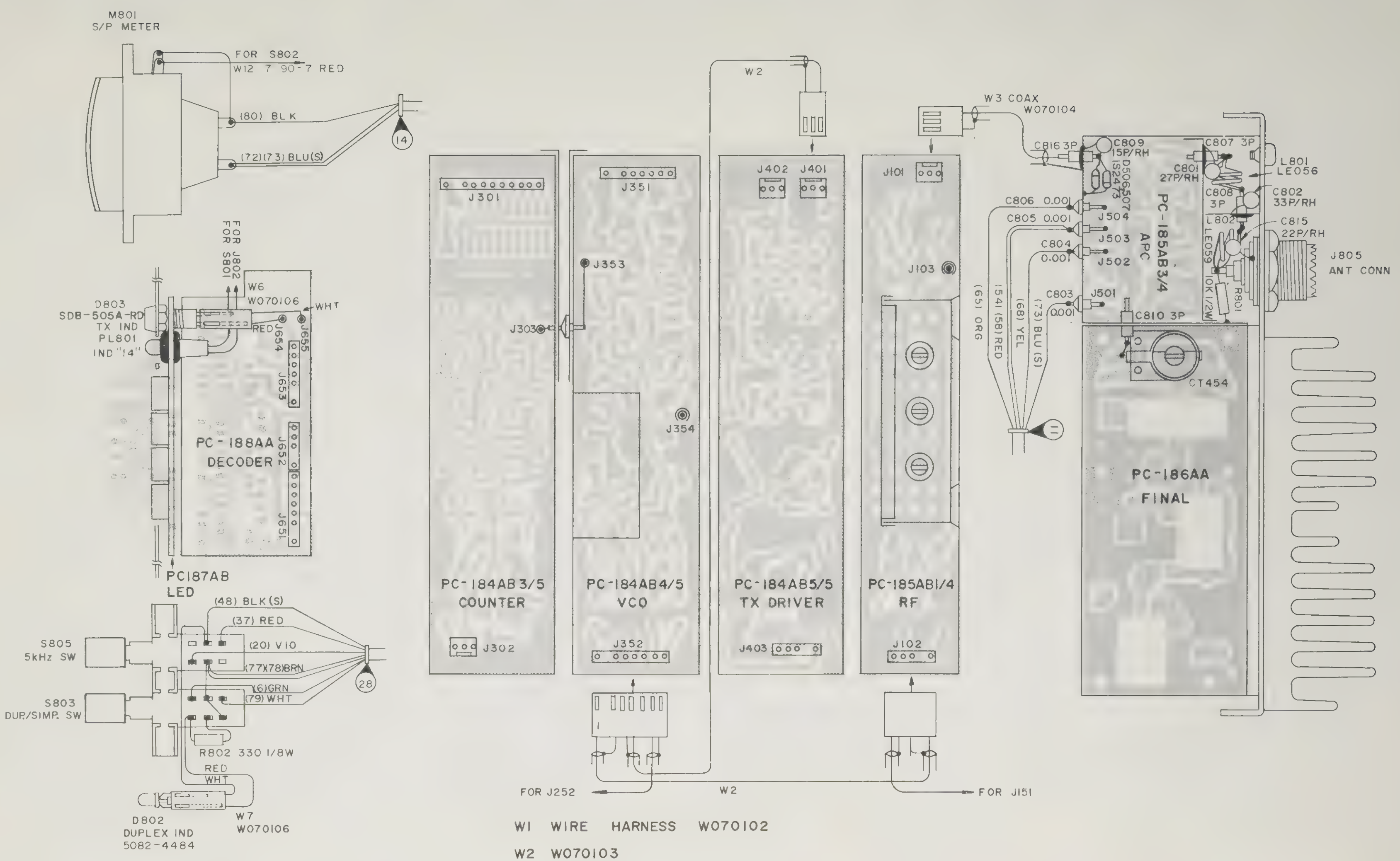
WIRING DIAGRAM



W1 WIRE HARNESS W070102

W2 W070103

WIRING DIAGRAM



W1 WIRE HARNESS W070102

W2 W070103

PARTS LIST

CASE PARTS

REF.NO.	DESCRIPTION	PART NO.
1	Case, Top	
2	Case, Bottom	
3	Mounting Bracket	
4	Chassis, Main	
5	Chassis, (Rear)	
6	Panel, Front	
7	Shield Case (Herical)	
8	Shield Plate	
9	Shield Case (A)	
10	Cover, Final	
11	Shield Case, APC	
12	Lid, Shield (A), APC	
13	Lid, Shield (B), APC	
14	Heat Sink, I.C.202	
15	Plate, Shield, VCO	
16	Holder, Speaker	
17	Heat Sink, Final	
18	Stand	
19	Holder. P.C.B.	
20	Knob, 100Khz selector	
21	Knob, 10Khz Selector	
22	Knob, Band Selector & TX offset	
23	Knob, Volume	
24	Kbob, Squelch	
25	Plate name, Brand	
26	Heat-Sink, Chassis	
27	Window, Frequency	
28	Label, FCC	
J802	Jack, Microphone JK-058	
J805	Connector, Antenna JK-035	
J804	Jack, Ext.Speaker JK-010	
J801	Jack, DC Power JK-059	
J803	Accessory Jack SK-019	
	Label, Serial No., Display Box	
	Label, Serial No., Chassis	
	Label, Warning, DC Power Cord	
	Plate, Mike	

MISCELLANEOUS

REF.NO.	DESCRIPTION	PART NO.
	Microphone MK-045	
SP801	Speaker SP-045	
M801	Meter MT-066	
X704, 705	Crystal Socket SK-010	
TP351,251,252,401	Test Terminal TP-019	
P801	Plug, Ext. Speaker (PG-003)	
PL-801	Pilot Lamp PL-053	
P801	DC Power Plug PG-003 ACC.	
F801	Fuse 6A FS-006	
	Microphone Hanger YY-016	
	Accessory Plug PG-033	
	Styroform Holder, Front	
	Styroform Holder, Back	
	Display Box	
	Owner's Guide	

CRYSTALS

REF.NO.	DESCRIPTION	PART NO.
X-301	QX-076 10.240MHz	
X-252	QX-076 13.678MHz	
X-251	QX-076 13.900MHz	
X 702	QX-076 16.300MHz	
X-151	QX-076 16.445MHz	
X-701	QX-076 16.900MHz	
X-703	QX-076 17.500MHz	
FT-151	Crystal Filter FL-035	
FT-152	Ceramic Filter FL-039	
FT-153	Ceramic Discriminator FL-015	
FT-101	Helical Resonator FL-041	

SWITCHES & CONTROLS

REF.NO.	DESCRIPTION	PART NO.
S-804, 808	Rotary Switch, Band MHz, & TX offset SR-041	
S806	Rotary Switch, 100KHz & 10KHz Selector, SR-142	
S-803	Push Switch, 5KHz up & Duplex/ Simplex	
S-802	Switch, Power Hi-Low SW-050	
VR-801/802 (S-801)	Control, Volume/Squelch with Switch RV-179	

INDUCTANCE

REF. NO.	DESCRIPTION	PART NO.
L103, 151	Coil LA-151	
L152	Coil LA-135	
L101, 406, 353, 104	Coil LA-169	
L407	Coil LA-177	
L102	Coil LC-117	
L405	Coil LA-170	
L402, 401	Coil LA-171	
L403, 354	Coil LA-172	
L404	Coil LA-176	
L256	Coil LA-173	
L255	Coil LA-174	
L253, 254	Coil LA-175	
L801	Coil LE-056	
L451, 456, 457	Coil LE-057	
L503	Coil LE-058	
L802	Coil LE-059	
L408, 452, 454	Coil LE-060	
L502	Coil LE-061	
L352	Coil LC-118	
L257, 355	Micro Inductor 10μH	
L301	Micro Inductor 100μH	
L153	Micro Inductor 390μH	
L105, 154, 251, 252 258, 351, 701	Micro Inductor LZ012 470μH	
L302, 303	Micro Inductor LZ013 1μH	
L156	Micro Inductor LZ011 5.6μH	
L155, 201	Micro Inductor LZ014 2.7μH	
L803	Choke Transformer TF-041	
L504	Coil LD-018	
L501	Coil LD-064	
L453, 455	Coil LD-070	

SEMICONDUCTORS

REF. NO.	DESCRIPTION	PART NO.
IC152, 352	IC TS-7061AP	
IC151	IC TA-7060P	
IC201	IC TA-7063P	
IC202	IC TA-7204P	
IC351	IC MC-78L08cp	
IC801	IC μPC-143G05	
IC301	IC μPD-857CW	
IC302	IC μPC-1008C	
IC304	IC N-7473A	
IC651, 652, 653	IC N-7447B	
Q101, 102, 151, 256, 355, 356, 401, 402, 403	FET 3SK45-B	
Q354	FET 2SK-55-D	
Q351, 352, 353	Transistor 2SC458LGC	
Q201, 202, 203, 301, 357, 555, 556	Transistor 2SC458C	
Q152, 153, 251, 252, 253, 254, 257, 304, 306, 701, 702, 703, 704, 705, 706	Transistor 2SC1675-L	
Q255, 303, 305, 404	Transistor 2SS763-C	
Q302, 552, 554, 557	Transistor 2SA733-P	
Q551, 558	Transistor 2SB544-E	
Q553	Transistor 2SD400-E	
Q801	Transistor 2SD313-E	
Q405	Transistor 2SC2053	
Q451	Transistor 2SC1970	
Q452	Transistor 2SC1972	
Q453	Transistor 2SC1946	
D203, 251, 252, 303, 304, 553, 554, 651, 652	Diode 1S2473	
D201, 202, 301, 302, 501, 502, 505, 506 507	Diode 1S2473	
D152, 153, 154, 155	Diode 1N-60P	
D151	Zener Diode BZ-081	
D351	Varicap 1S2339G	
D352	Varicap 1S2688F	
D503, 504	Diode MI-402	
D601, 602, 603, 604	LED TLR 313	
D803	LED SDB-505A-RD	
D802	LED 5082-4484	
D551, 552	Varistor KB-262	
D801	Diode S3V-10	

RESISTORS

All Resistors not shown on this parts list are carbon 1/4W, see schematic for specific values.

REF. NO.	DESCRIPTION	PART NO.
R-451	Carbon 100 Ohm 1/2WJ	
R-501, 502	Carbon 470 Ohm 1/2WJ	
R-801	Carbon 10K Ohm 1/2WJ	
R-424	Carbon 10 Ohm 1/2WJ	
R-802	Carbon 330 Ohm 1/8WJ	
R-364	Carbon 220 Ohm 1/8WJ	
R-803, 363	Carbon 100 Ohm 1/8WJ	
R-360, 362	Carbon 22K Ohm 1/8WJ	
R-173	Solid 82 Ohm 1WJ	
R-551	Metalized Resistor 330 Ohm 2WJ	
RT-501	Semi-Fixed RV-182 500 Ohm	
RT-551, 553	Semi-Fixed RV-182 5K Ohm	
RT-152, 351	Semi-Fixed RV-182 10K Ohm	
RT-151, 502	Semi-fixed RV-182 50K Ohm	
RT-401	Semi-fixed RV-189 300 Ohm	
RT-552	Semi-fixed RV-182 1K Ohm	

CAPACITORS

All capacitors not shown on this parts list are ceramic, 50V, see schematic for specific values.

REF. NO.	DESCRIPTION	PART NO.
C-470, 807, 808, 810 816	Feed through CZ-023 3P	
C-391, 471, 472, 473 803, 804, 805, 806 811	Feed through CZ-024 0.001P	
C-407	Minic 0.56P 500VK	
C-102	Minic IP 500VK	
C-213, 551	Alminium 0.1μ 25V	
C-182	Alminium 0.22μ 16V	
C-459, 465	Tantalum 2.2μ 25V	
CR-301, 302, 303, 304 305, 306, 307, 308 309	C.R. Components HA-001	
C-210, 356	Electrolytic 0.47μ 50V	
C-185, 225, 385, 557	Electrolytic 1.00μ 50V	
C-202, 381, 313	Electrolytic 4.70μ 25V	
C-201, 211, 212, 214 219, 311, 355, 382 383, 563, 566	Electrolytic 10.00μ 16V	
C-360	Electrolytic 22.00μ 16V	
C-314, 386	Electrolytic 33.00μ 16V	
C-216, 221, 224	Electrolytic 47.00μ 16V	
C-352	Electrolytic 100.00μ 16V	
C-226	Electrolytic 220.00μ 16V	
C-552	Electrolytic 470.00μ 16V	
C-228	Electrolytic 1000.00μ 16V	
C-204	Mylar 0.0022μ 50VK	
C-177, 179, 181	Mylar 0.001μ 50VK	
C-171, 180, 184, 203 207, 208, 220, 359 362, 388	Mylar 0.01μ 50VK	
C-217, 357. 358, 361	Mylar 0.022μ 50VK	
C-206, 312, 365, 387	Mylar 0.039μ 50VK	
C-152, 153, 154, 155 156, 157, 161, 260 261, 317, 321	Ceramic 0.01μ 25V ZY	
C-165, 251, 252, 257 263, 264, 268, 269 273, 277, 279, 318 319, 326, 354, 366 373, 375, 507, 555 706, 280, 281, 282	Ceramic 0.022μ 25V ZYG	
C-163, 164, 166, 167 169, 170, 172, 173 174, 175, 176, 183 186, 315, 316, 707	Ceramic 0.039μ 25V ZYG	
CT-451, 452, 453	Trimmer CV-024 30P	
CT-251, 252, 253 254, 401, 402 501, 701, 702 703, 704, 705	Trimmer CV-028 20P	
CT-454	Trimmer CV-037 25P	

CONNECTOR WAFER-ASS'Y

REF. NO.	DESCRIPTION	PART NO.
J-101, 151, 202, 252 253, 302, 401, 402 201	Wafer 5045-03A 3pin	
J-102, 251, 403, 554 652	Wafer 5048-04A 4pin	
J-551	Wafer 5048-05A 5pin	
J-553, 653, 152	Wafer 5048-06A 6pin	
J-351, 352, 651	Wafer 5048-07A 7pin	
J-701, 552	Wafer 5048-08A 8pin	
J-602	Wafer 5049-08A 8pin	
J-301	Wafer 5048-10A 10pin	
J-153, 203, 204, 354 103	Terminal Pin TP-027	
J-603	Wafer 3094-8A	
J-601	Wafer 3094-9A	

CONNECTOR HOUSING ASS'Y

REF. NO.	DESCRIPTION	PART NO.
P-102, 251, 403, 554 652	Housing SD-5047-4	
P-551	Housing SD-5047-5	
P-152, 553, 653	Housing SD-5047-6	
P-351, 352, 651	Housing SD-5047-7	
P-552, 701	Housing SD-5047-8	
P-301	Housing SD-5047-10	
P-101, 151, 202, 252 201, 253, 302, 401 402	Housing SD-5051-3	
P-555, 556	Housing SD-3021-3	
P-153, 203, 204, 354	Housing 1855TL	
P-655	Housing SD-3021-2	
P-555, 556	Housing SD-3021-3	

NOTE: When ordering parts, it is essential to specify the correct model number and serial number of the unit.

LIMITED WARRANTY

Clegg Communications Corp. will repair or replace, at its option, and without charge, and FM-28 transceiver which fails due to defect in material or workmanship within 90 days of shipment to the purchaser.

The responsibility of the purchaser under this warranty is to return the product, freight prepaid, to Clegg Communications Corp., 208 Centerville Road, Lancaster PA 17603, along with sufficient information to define the specific malfunction.

This warranty gives you specific legal rights. You may have additional rights which vary from state to state.

CLEGG DIV. OF ISC
208 CENTERVILLE RD.
LANCASTER. PA 17603

Printed in Japan

Clegg

PRELIMINARY OWNER'S MANUAL

CLEGG FM-DX

GENERAL DESCRIPTION

The FM-DX is a solid state VHF FM Transceiver offering unique features never before available to the 2-Meter amateur.

The unit employs digital technology in a phase locked loop scheme to control frequency over the full 2-Meter band with additional coverage (143.5 to 148.5 MHz) for operation in the MARS and other Amateur related services.

Operation features include a 6 digit, direct frequency readout with brilliant numeric LEDs. The transmitter frequency tracks with the selected receiver frequency and is programmable for either Simplex or Repeater operation. Capability is provided for all standard repeater spreads with provisions for several non-standard spreads.

A panel selector permits instant choice between more than 35 watts output and 1 watt output.

The receiver section employs the latest in component, circuit and solid state device technology to yield an unprecedented marriage of sensitivity, selectivity and freedom from spurious responses. A meaningfull S-Meter significantly enhances operating convenience of the FM-DX.

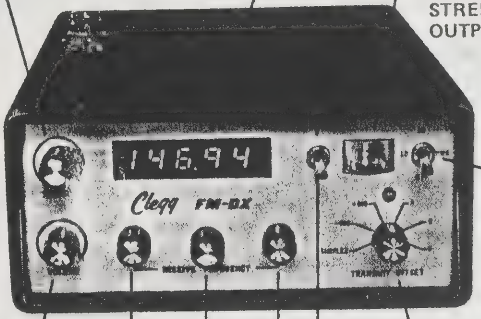
Reliability and servicibility has been achieved by a unique extremely rugged modularized construction technique employing a solid extruded main frame.

The FM-DX is supplied with a high quality, attractive dynamic microphone and includes provisions for a wide complement of accessory capabilities common to 2-Meter FM activity.

THRESHOLD AT .15uv TO TIGHT SQUELCH AT 30uv

LARGE, BRILLIANT LED FREQUENCY READOUT (6th digit lights for 5KHz)

ILLUMINATED METER. SIGNAL STRENGTH ON RECEIVE; RELATIVE OUTPUT ON TRANSMIT



SELECTS TRANSMITTER POWER BETWEEN A BIG 30 + WATTS OR A COOL 1 WATT FOR LOCAL USE

FM-DX Amateur Net
$589.95

1MHz STEPS

100KHz STEPS

10KHz STEPS

0/5 KHz STEPS

INSTANTLY DIAL UP ANY RECEIVE FREQUENCY FROM 143.5 to 148.5MHz IN 5KHz STEPS!

SELECTS DIFFERENTIAL BETWEEN RECEIVE AND TRANSMIT FREQ. ± 600KHz AND SIMPLEX (supplied) PLUS PROVISION FOR THREE ADDITIONAL SPREADS

ADJUST VOLUME UP TO A LOUD 1.5 WATTS

II FRONT PANEL CONTROLS AND INDICATORS

A. POWER SWITCH:

The three position toggle switch serves the dual function of ON/OFF control and transmitter HIGH or LOW power selection.

B. FREQUENCY CONTROLS:

A total of 5 front panel controls are involved in the frequency selection process of the radio. Four of these are used to select Receive Frequency.

1. MHz SELECT (10 position rotary switch)
2. 100 KHz SELECT (10 position rotary switch)
3. 10 KHz SELECT (10 position rotary switch)
4. 0 or 5 KHz SELECT (2 position toggle switch)

The selected frequency is read directly on the 6 digit numeric LED display. (For operating convenience the 6th digit is blanked when a zero would be displayed; the first two digits are always 1 and 4.)

For example, to set the receiver to 146.52:

1. MHz SELECT rotated until third digit is 6
2. 100 KHz SELECT rotated until fourth digit is 5
3. 10 KHz SELECT rotated until fifth digit is 2
4. 0 or 5 KHz SELECT switch to 0 position

The FM-DX Receiver will then be precisely tuned to 146.52.

The remaining frequency control (affecting Transmit Frequency only) is the TRANSMIT OFFSET. The transmitter frequency is always related to the Receive Frequency. When the TRANSMIT OFFSET is in the SIMPLEX position the Transmit and Receive frequencies are identical.

Repeater operation simply requires setting the TRANSMIT OFFSET control to the setting appropriate to the particular repeater to be used.

For example, to work with a normal 146.13/146.73 repeater the Receiver would be set to the 146.73 repeater output; 146.73 would be displayed on the LED Readout. The TRANSMIT OFFSET would be set to -600; the transmitter would then be on the repeater input frequency, 146.13.

The TRANSMIT OFFSET control provides for 5 different repeater separations (in addition to Simplex). Simplex -600 KHz and +600 KHz are supplied as standard equipment. The user can supplement this capability at any time by adding a single plug in crystal for each additional separation required. No adjustments are required.

A PHASE LOCK INDICATOR light is located just above the TRANSMIT OFFSET control. This indicator will normally be extinguished but may flash on briefly when changing frequency. Transmission should not be made while this lamp is illuminated or flashing!

C. ADDITIONAL RECEIVER CONTROLS AND INDICATOR:

Conventional SQUELCH and VOLUME control are provided. The SQUELCH control, when advanced to the extreme clockwise position causes the radio to "mute" until a signal of approximately 25 microvolts is being received. When retarded (ccw) to the threshold point the receiver will be actuated by weak signals.

When the Fm-DX is in the receive mode the panel meter serves as a signal strength meter. Signals just barely perceptible will be indicated by a visible deflection of the meter and deflection will be in proportion to signal strength. Full scale deflection is achieved with an input signal strength of approximately 30 microvolts.

III INTERCONNECT AND ACCESSORY FACILITIES

MICROPHONE The FM-DX is supplied with a high quality dynamic PTT microphone fitted with a right angle, three pole male plug. The matching receptacle is located on the left side of the transceiver.

EXTERNAL SPEAKER A phono plug receptacle is located on the rear panel of the units to accomodate an external speaker wired with a conventional phono plug. Insertion of the external speaker automatically disables the internal speaker. Speaker impedance may be from 3.2 to 8 ohms.

ANTENNA CONNECTOR is a conventional UHF type located on the rear panel and accepts the standard PL259 coaxial connector.

POWER SUPPLY connection is made via a molded nylon polarized connector. The FM-DX is supplied with a fused cable with mating connector. Replacement or spare cables may be purchased from Clegg. (Order Assembly Number 0200020.) The in-line fuse is rated at 15 amps and is a conventional 32 volt automotive part. RED LEAD IS POSITIVE; BLACK IS NEGATIVE AND CASE GROUND

ACCESSORY RECEPTACLE

A 7 pin socket located on the right side of the transceiver affords provisions for inter-connection of accessory devices such as tone generators and remote controls.

Connections are:

1 Spare (not connected)
2 High side of VOLUME CONTROL
3 +9 volts DC (both TX and RX)
4 Parallel with microphone PTT control
5 Receiver audio (Parallel with speaker line)
6 Transmitter audio input (Parallel with microphone)
7 Ground

The Fm-DX owner will find this facility accomodates most requirements. Simple modifications would accomodate special requirements of accessory connections or controls. Consult Clegg Sales and Service if additional information is required.

FM-DX SPECIFICATIONS

RECEIVER SPECIFICATIONS

FREQUENCY RANGE: 143.5 to 148.5 MHz in 5 KHz Steps

SENSITIVITY: .25 uv (max.) for 12db SINAD
.45 uv (max.) for 20db Quieting
.15 uv (max.) Squelch Threshold

SELECTIVITY: 15 KHz (min.) at 6db
60db (min.) at 30 KHz
adjacent channel, 16F3 system

IMAGE REJECTION: 66db

IF (10.7 MHz) REJECTION: 70db (min.)

INTERMODULATION ATTENUATION: 66db (min.)

AUDIO OUTPUT: 1.5 Watts at 10% THD to internal or external 3.2 to 8 OHm load

AUDIO RESPONSE: Standard EIA deemphasis curve of approximately 6db per octave, 300 to 3000Hz.

SQUELCH RANGE: .15uv (max.) at threshold setting. Approx. 30uv at tight squelch.

SIGNAL STRENGTH METER: Approximately 50db range with .25uv threshold.

TRANSMITTER SPECIFICATIONS

FREQUENCY RANGE: 143.5 to 148.5 MHz in 5 KHz Steps

FREQUENCY CONTROL: Transmitter automatically tracks receiver frequency with programmable OFFSET. Three programmed OFFSETS provided as standard (SIMPLEX and ±600 KHz). Provisions for simple field installation of any 3 additional OFFSETS.

POWER OUTPUT: (at 13.8 VDC)

HI POSITION: 35 Watts (min.)

LOW POSITION: Approx. 750 mw

SPURIOUS OUTPUT: Non Harmonic spurs 60db below carrier.

DEVIATION CAPABILITY: 8 KHz; Factory adjusted to 5 ±.5 KHz.

AUDIO RESPONSE: Standard EIA Pre-emphasis characteristics 300 to 3000 Hz, approx. 6db per octave.

RESIDUAL HUM & NOISE: 40db (min.) below 3 KHz deviation.

GENERAL

SUPPLY VOLTAGE: 12.0 to 14.3 VDC; (13.5 to 13.8 recommended) NEGATIVE GND

CURRENT DRAIN AT 13.8 VDC supply

Receive: 1.3A (typical)
Transmit: (LO) 4A (max.)
Transmit: (HI) 10A (max.)

DIMENSIONS: 7" wide x 3 1/8" High x 10 1/2" Deep

NET WEIGHT: 5 1/2 pounds; SHIPPING WEIGHT: 7 1/2 pounds

ACCESSORY RECEPTACLE: Provisions for remote control and external tone inputs. 7 pin receptacle and plug.

FREQUENCY SYNTHESIZER SPECIFICATIONS

TYPE: Digital (TTL Logic) control of phase locked VCO.
Controlled by 4 panel controls:

1. 1 MHz Steps
2. 100 KHz Steps Decade Switches, 10 positions
3. 10 KHz Steps
4. 0/5 KHz Toggle Switch

Variable ÷ N system referenced to single 4 MHz crystal.

Transmit Frequency hetrodyne - derived from receiver VCO

DISPLAY: 6 Digit direct numeric readout of Receiver frequency. Last digit displayed only on 5 KHz steps.

CALIBRATION ACCURACY: (25°C, 13.8 VDC supply)

RECEIVER: ±200 Hz* at any 10 KHz step. (Possible additional error of 130 Hz on 5 KHz increments only).

TRANSMITTER: ±200 Hz typical, 300 Hz (max.)

* Typical within 6 months of manufacture. Internal trimmer permits zero adjust.

TEMPERATURE STABILITY: ±500 Hz; 30° to 100°F

±1200 Hz; -10 to +130°F

VOLTAGE STABILITY: ±200 Hz; 11.8 to 14.3 VDC

LOOP LOCKUP TIME:

10 KHz Step	50 Milliseconds (max.)
100 KHz Step	150 Milliseconds (max.)
1 MHz Step	350 Milliseconds (max.)

NOTE: Unlike other 2 Meter synthesizers the FM-DX does not have a lock-up delay when switching between Receive and Transmit.

ACCESSORIES AVAILABLE

MODEL 031A - 13.8 Volt, 10 Amp Base Station Power Supply and Speaker.

TRANSMIT OFFSET CRYSTALS: +1000 KHz, -1000KHz, +1035 KHz, -585 KHz. (Other offsets available on special order.

TOUCH TONE PAD - (Available in June)

IV MOBILE INSTALLATION (NEGATIVE GROUND SYSTEM ONLY)

The FM-DX, because of its significantly higher power rating than conventional transceivers, may require more care in installation. Current drain on HIGH POWER transmit may be as high as 10 amperes. To assure full performance the power cable between the battery source and the radio should be of sufficient conductor size to provide more than 12.3 volts at the transceiver.

Cigarette lighter adapters or alligator clip arrangements are not satisfactory for use with the FM-DX in the HIGH POWER mode. For temporary or emergency operation these expediencies may be employed if the transceiver is operated in the LOW POWER position.

The mobile mount supplied with the FM-DX provides flexibility and versatility of installation. No particular constraints on position or location are imposed by the radio itself; positioning the unit for operation accessibility would be the primary consideration. Where practical to do so the unit should be placed where direct sunlight is least apt to fall directly on the LED display. The speaker is located on the bottom of the unit therefore this area should remain unobstructed.

No radio works better than the antenna to which it is connected. Many choices exist for mobile installations. Where practical roof top mounting is superior to rear deck mounting and rear deck mounting is usually superior to bumper type mounts. Fresh, new coaxial cable should be used. RG-58 deteriorates measurable with age. If practical RG-8 is preferable. However, for the short lengths associated with mobile installations the difference may not be significant.

V BASE STATION INSTALLATION

The extreme frequency versatibility of the FM-DX makes it an ideal unit for the FM'er who enjoys channel hopping from a base station. Unlike some earlier synthesized units the FM-DX has characteristics ideally suited for operation with large, high gain beam antenna for simplex DXing. Receiver design provides excellent freedom from overload and intermodulation; transmitter design provide an excellent spectrum purity.

Base operation requires a reasonably regulated power source capable of supplying 13.5 ± .5 VDC at 10 amperes. Regulation should be such that voltage does not fall below 12.3 volts at 10 amperes and does not rise above 14.5 volts at no load.

The Clegg Model 031A Power Supply provides an ideal base station power source for the FM-DX. In addition it includes an auxiliary speaker matched to the FM-DX.

Antenna selection for base station operation is very much a function of the owner's operation preferences and his geographical location. Most operation can be done with a simple omnidirectional vertical. However, a good vertically polarized beam may yield considerably expanded operating enjoyment in many cases. In addition to providing extended range for both Simplex and Repeater operation the beam permits the station who is located within range of two repeaters on the same frequency to access one without interfering with the other!

A most significant consideration in the base station, regardless of the antenna used, is the choice of coaxial feed line. When cable lengths of more than 50 feet or so are required RG8A/U is a must; where lengths of more than 100 feet are to be used the operator is wise to consider one of the lower loss cables. Reference is made to any of the VHF handbooks for information on the loss characteristics of available cables.

FM-DX OVERALL BLOCK DIAGRAM

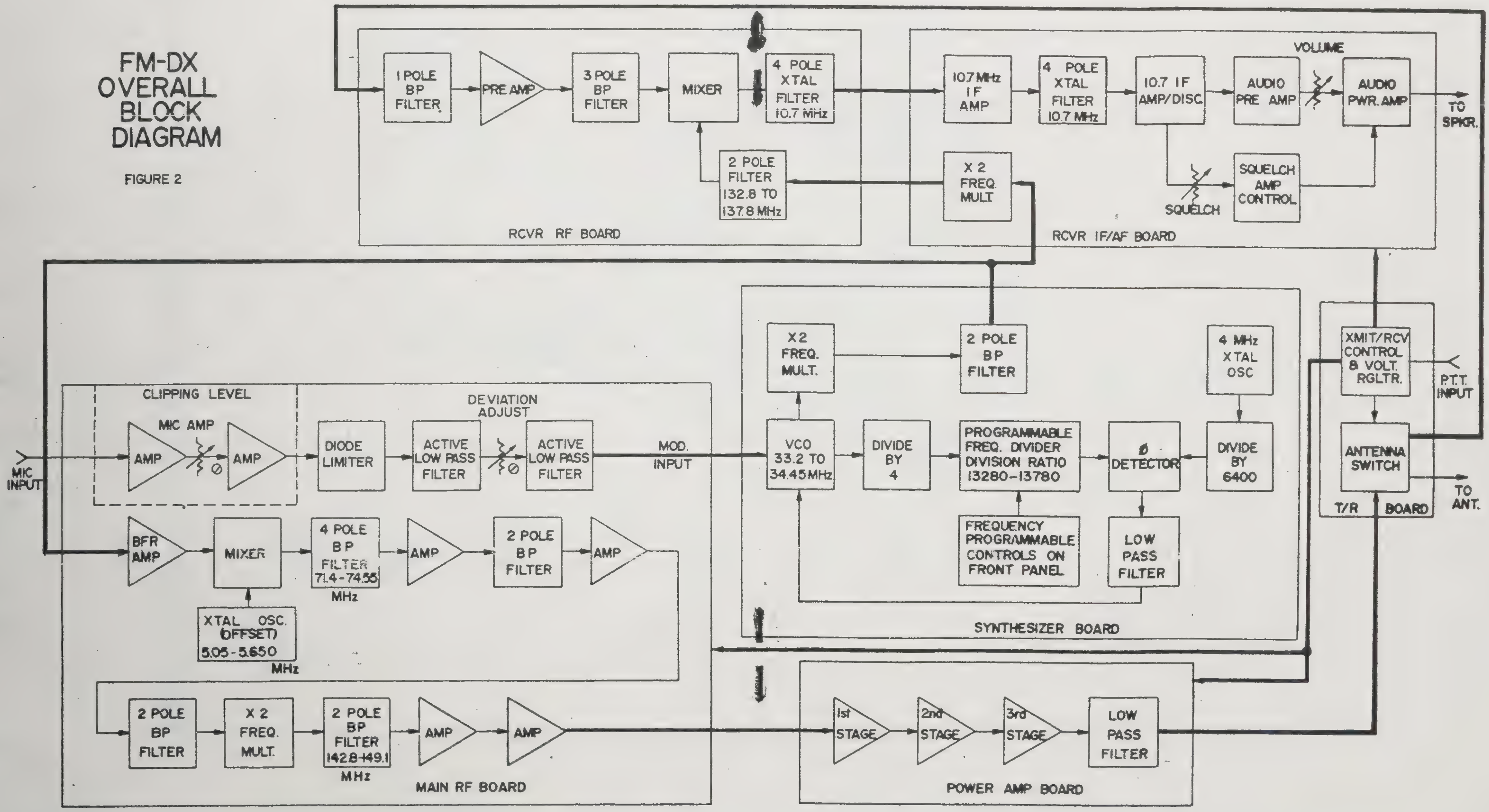
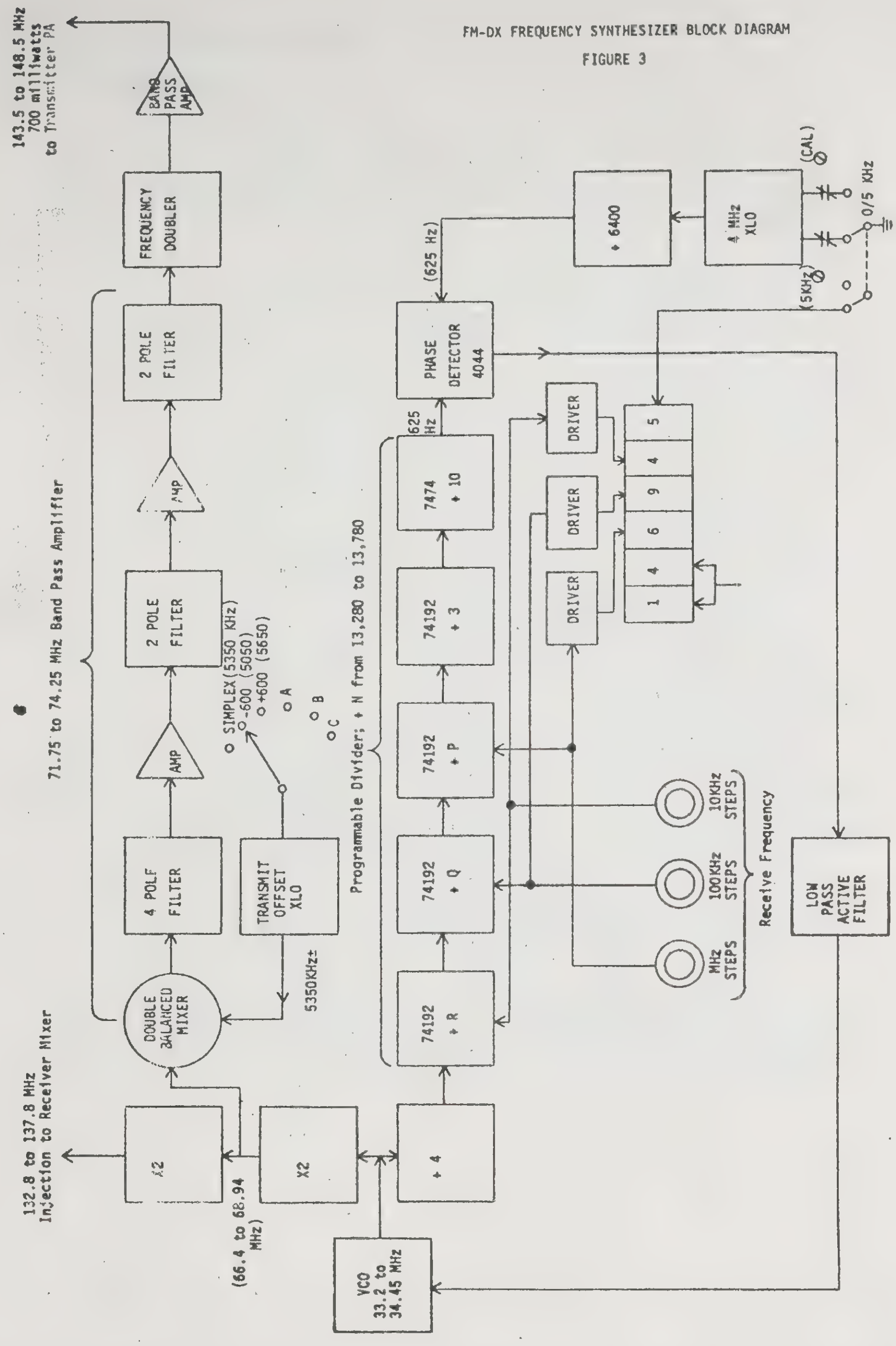


FIGURE 2

FM-DX FREQUENCY SYNTHESIZER BLOCK DIAGRAM

FIGURE 3



VI FREQUENCY CONTROL SYSTEM

DIGITAL SYNTHESIZER:

The FM-DX smploys digital counting technique and a phase locked voltage controlled oscillator (VCO) for direct generation of the injection signal for the receiver. The same phase locked VCO output is combined in a mixer along with the output of a switchable crystal oscillator to derive the transmitter frequency. A block diagram of this processing is shown in Fig. 2.

The VCO operates over the range from 33.2 MHz to 34.45 MHz. The output is frequency multiplied 4 times to provide the required 132.8 to 137.8 MHz receiver injection frequency.

Simultaneously, the VCO frequency is divided by 4 to yield a signal between 8300 and 8612.5 KHz. This latter signal feeds five cascaded programmable counters. The net count of these counters can be programmed by three panel controls so that they divide the input frequency by any selected number from 13,280 to 13,780. Output from the divider string provides one of two inputs to a phase detector. The second input is a fixed 625 Hz signal derived from a precise 4000 KHz crystal oscillator and a fixed divide-by-6400 digital circuit.

The phase detector employed (a Motorola MC4044) is of the type wherein a steady state output voltage exists only when both input and output signals are identical in both frequency and phase. In this application this condition is satisfied only when the divided down VCO frequency equals the 625 Hz reference frequency. The filter and DC amplifier circuits following the phase detector output are applied to the VCO and consequently tune the VCO to that frequency which satisfies this 625 Hz condition.

A numerical example is in order. Let us say our programmable divider is arbitrarily set to divide by 13,600. The phase detector filtered and amplified output will force the VCO to 13,600 x 4 x 625 Hz or 34.000 MHz. If the VCO tends to drift higher the 625 Hz resultant will also increase and the phase detector will respond with a corrective output voltage returning the VCO to the correct frequency. With the VCO locked on 34.000 MHz the receiver will be tuned to (34.0 x 4) + 10.7 MHz or 146.70 MHz.

Similarly, if we wish to change from 146.70 to 146.71 MHz we merely change the divider from the previous 13,600 number to 13,601. Each change of 1 in our divide numeral results in a 10 KHz change in receive frequency. Furthermore, our receive frequency in KHz is always 10 times our divide numeral plus 1070; i.e. 10(N + 1070) KHz.

The FM-DX controls and LED display have been programmed to do the above arithmetical computation internally. Consequently when the Receive Frequency controls are switched so that 146.70 is displayed on the LED's the divider is automatically set to the corresponding 13,600 value and the receiver is tuned to 146.70.

To accomodate the 5 KHz increments controlled by the 0/5KHz toggle switch the 4000 KHz reference oscillator is moved slightly in frequency and consequently, the 625 Hz reference moves a proportional amount. (The 5 KHz shift which results is only precise at one frequency, 147.00 MHz. However, the error in the 5 KHz shift is less than a 100 Hz at frequency extremes.)

TRANSMIT SYNTHESIZER:

The FM-DX is configured so that the transmit frequency is always slaved to the receive frequency. When the radio is in the Simplex mode the transmit frequency is the same as the receive frequency. For repeater operation the transmit frequency can be above or below the selected received frequency. In addition to the normal plus or minus 600 KHz repeater spacings the FM-DX will accomodate three additional choices of spacing. The TRANSMIT OFFSET switch controls this selection. Transmit frequency is produced by combining two signals in a solid state double balanced mixer:

1. The second harmonic of the VCO
2. The output of a switchable crystal oscillator

The sum of these two frequencies is then doubled in frequency and becomes our transmitter output frequency.

Let us refer again to the arithmatic example use in the previous section. The receiver has been programmed to receive 146.70 MHz; our VCO is consequently on 34.00 MHz. This VCO frequency is doubled to 68.00 MHz and is applied to the double balanced mixer. Our crystal oscillator is on 5.35 MHz and is also applied to the mixer. Our mixer output at 73.35 MHz (68.0 + 5.35) is amplified and doubled to 146.70 MHz. Similarly if we switch our crystal oscillator to 5.05 MHz our mixer output becomes 73.05 MHz and our transmitter is then on 146.10 MHz. The first example, of course, represents the simplex mode whereas the second represents the typical 146.70 output, 146.10 input repeater mode.

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The receiver section of the FM-DX has been designed to afford fractional microvolt sensitivity combined with immunity from undesireable spurious responses.

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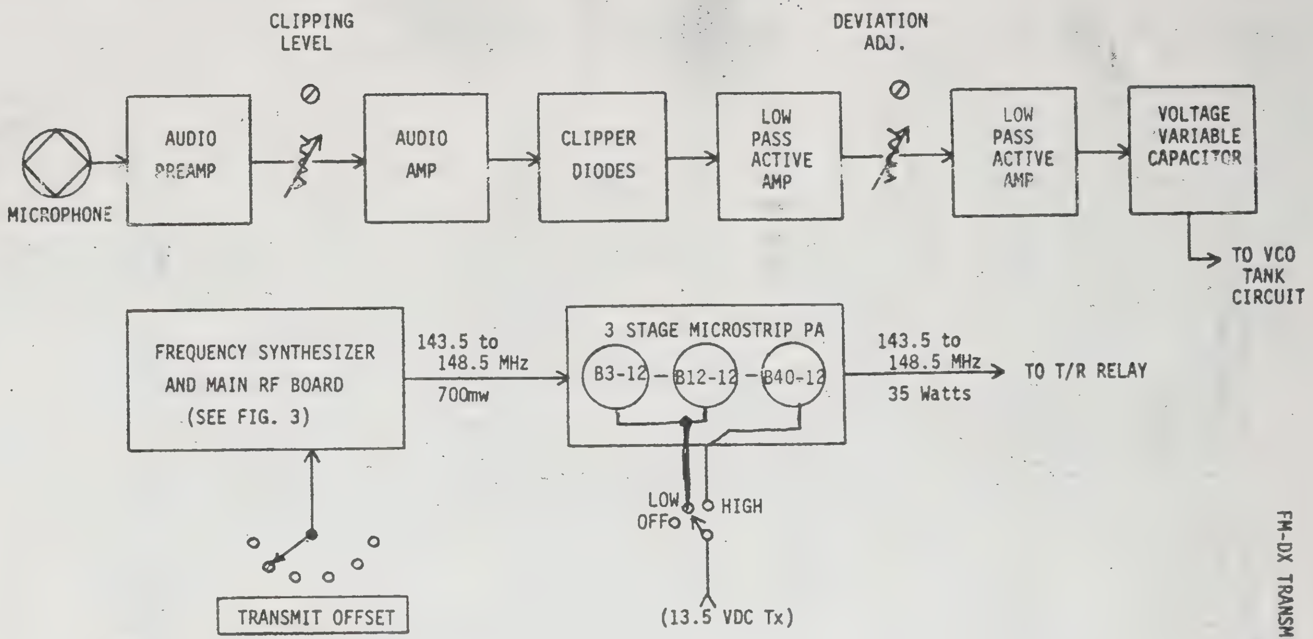

OFFSET CRYSTAL FREQUENCIES

SIMPLEX	5350.0 KHz	Standard Complement
-600	5050.0 KHz	
+600	5650.0 KHz	
+1000	5850.0 KHz	
-1000	4850.0 KHz	
-585	5057.5 KHz	
+1035	5867.5 KHz	

FM-DX TRANSMITTER BLOCK DIAGRAM
FIGURE 4

VIII TRANSMITTER DESIGN

The transmitter section of the FM-DX has been designed with great emphasis placed on spectral purity of the output signal. All transmit functions up to the .7 watts level are contained on the Main RF P/C module which is shared with the non-digital portion of the frequency synthesizer. A functional block diagram of the transmitter is shown in Fig. 4.

The VCO is phase locked to a frequency in the 34 MHz region as determined by the desired RECEIVE FREQUENCY set by the panel controls and displayed by the LEDs. The VCO frequency is doubled and filtered and applied at one input to a solid state double balanced mixer. The other input to this mixer is provided by the TRANSMIT OFFSET XLO which is at 5.35 MHz for Simplex and between 4.6 and 6.1 MHz for useable Repeater offsets.

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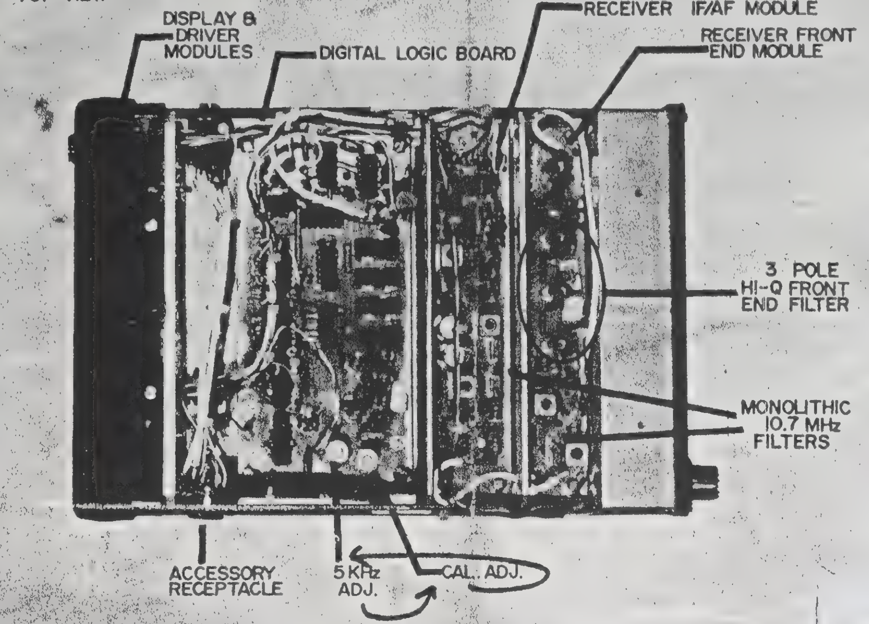

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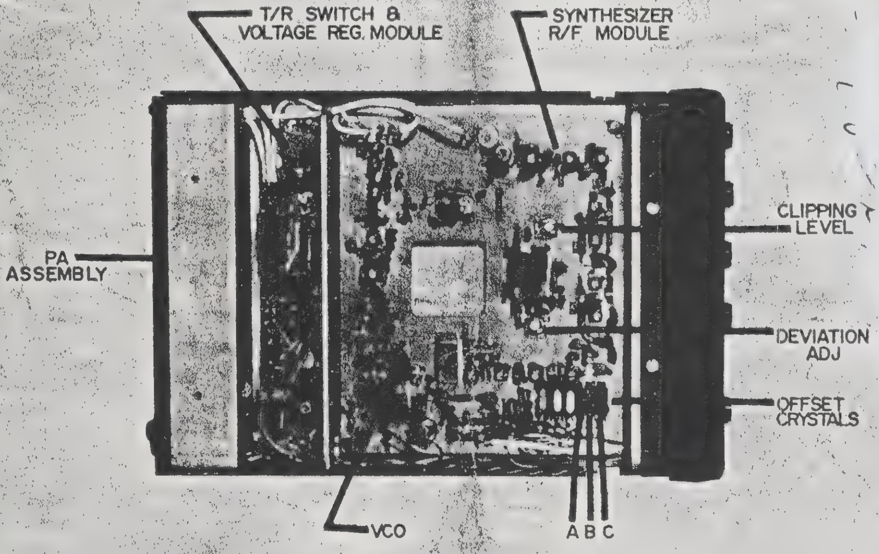


Clegg

PRELIMINARY OWNER'S MANUAL

CLEGG FM-DX

GENERAL DESCRIPTION

The FM-DX is a solid state VHF FM Transceiver offering unique features never before available to the 2-Meter amateur.

The unit employs digital technology in a phase locked loop scheme to control frequency over the full 2-Meter band with additional coverage (143.5 to 148.5 MHz) for operation in the MARS and other Amateur related services.

Operation features include a 6 digit, direct frequency readout with brilliant numeric LEDs. The transmitter frequency tracks with the selected receiver frequency and is programmable for either Simplex or Repeater operation. Capability is provided for all standard repeater spreads with provisions for several non-standard spreads.

A panel selector permits instant choice between more than 35 watts output and 1 watt output.

The receiver section employs the latest in component, circuit and solid state device technology to yield an unprecedented marriage of sensitivity, selectivity and freedom from spurious responses. A meaningfull S-Meter significantly enhances operating convenience of the FM-DX.

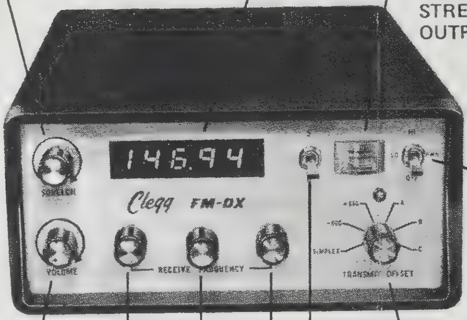
Reliability and servicibility has been achieved by a unique extremely rugged modularized construction technique employing a solid extruded main frame.

The FM-DX is supplied with a high quality, attractive dynamic microphone and includes provisions for a wide complement of accessory capabilities common to 2-Meter FM activity.

LARGE, BRILLIANT LED
FREQUENCY READOUT
(6th digit lights for 5KHz)

THRESHOLD AT .15uv TO
TIGHT SQUELCH AT 30uv

ILLUMINATED METER. SIGNAL
STRENGTH ON RECEIVE; RELATIVE
OUTPUT ON TRANSMIT



SELECTS TRANSMITTER
POWER BETWEEN A BIG
30 + WATTS OR A COOL
1 WATT FOR LOCAL USE

FM-DX Amateur Net
$589.95

1MHz STEPS | 100KHz STEPS | 10KHz STEPS | 0/5 KHz STEPS

INSTANTLY DIAL UP ANY
RECEIVE FREQUENCY FROM
143.5 to 148.5MHz IN 5KHz STEPS!

SELECTS DIFFERENTIAL
BETWEEN RECEIVE AND
TRANSMIT FREQ. ±600KHz
AND SIMPLEX (supplied)
PLUS PROVISION FOR THREE
ADDITIONAL SPREADS

ADJUST VOLUME UP
TO A LOUD 1.5 WATTS

FM-DX SPECIFICATIONS

RECEIVER SPECIFICATIONS

FREQUENCY RANGE: 143.5 to 148.5 MHz in 5 KHz Steps

SENSITIVITY: .25 uv (max.) for 12db SINAD
.45 uv (max.) for 20db Quieting
.15 uv (max.) Squelch Threshold

SELECTIVITY: 15 KHz (min.) at 6db
60db (min.) at 30 KHz
adjacent channel, 16F3 system

IMAGE REJECTION: 66db

IF (10.7 MHz) REJECTION: 70db (min.)

INTERMODULATION ATTENUATION: 66db (min.)

AUDIO OUTPUT: 1.5 Watts at 10% THD to internal or external 3.2 to 8 OHm load

AUDIO RESPONSE: Standard EIA deemphasis curve of approximately 6db per octave, 300 to 3000Hz.

SQUELCH RANGE: .15uv (max.) at threshold setting. Approx. 30uv at tight squelch.

SIGNAL STRENGTH METER: Approximately 50db range with .25uv threshold.

TRANSMITTER SPECIFICATIONS

FREQUENCY RANGE: 143.5 to 148.5 MHz in 5 KHz Steps

FREQUENCY CONTROL: Transmitter automattically tracks receiver frequency with programmable OFFSET. Three programmed OFFSETS provided as standard (SIMPLEX and ±600 KHz). Provisions for simple field installation of any 3 additional OFFSETS.

POWER OUTPUT: (at 13.8 VDC)

HI POSITION: 35 Watts (min.)

LOW POSITION: Approx. 750 mw

SPURIOUS OUTPUT: Non Harmonic spurs 60db below carrier.

DEVIATION CAPABILITY: 8 KHz; Factory adjusted to 5 ±.5 KHz.

AUDIO RESPONSE: Standard EIA Preemphasis characteristics 300 to 3000 Hz, approx. 6db per octave.

RESIDUAL HUM & NOISE: 40db (min.) below 3 KHz deviation.

GENERAL

SUPPLY VOLTAGE: 12.0 to 14.3 VDC; (13.5 to 13.8 recommended) NEGATIVE GND

CURRENT DRAIN AT 13.8 VDC supply

Receive: 1.3A (typical)
Transmit: (LO) 4A (max.)
Transmit: (HI) 10A (max.)

DIMENSIONS: 7" wide x 3 1/8" High x 10 1/2" Deep

NET WEIGHT: 5 1/2 pounds; SHIPPING WEIGHT: 7 1/2 pounds

ACCESSORY RECEPTACLE: Provisions for remote control and external tone inputs. 7 pin receptacle and plug.

FREQUENCY SYNTHESIZER SPECIFICATIONS

TYPE: Digital (TTL Logic) control of phase locked VCO.
Controlled by 4 panel controls:

1. 1 MHz Steps
2. 100 KHz Steps   Decade Switches, 10 positions
3. 10 KHz Steps
4. 0/5 KHz Toggle Switch

Variable ÷ N system referenced to single 4 MHz crystal.

Transmit Frequency hetrodyne - derived from receiver VCO

DISPLAY: 6 Digit direct numeric readout of Receiver frequency.
Last digit displayed only on 5 KHz steps.

CALIBRATION ACCURACY: (25°C, 13.8 VDC supply)

RECEIVER: ±200 Hz* at any 10 KHz step. (Possible additional error of 130 Hz on 5 KHz increments only).

TRANSMITTER: ±200 Hz typical, 300 Hz (max.)

* Typical within 6 months of manufacture. Internal trimmer permits zero adjust.

TEMPERATURE STABILITY: ±500 Hz; 30° to 100°F

±1200 Hz; -10 to +130°F

VOLTAGE STABILITY: ±200 Hz; 11.8 to 14.3 VDC

LOOP LOCKUP TIME:

10 KHz Step	50 Milliseconds (max.)
100 KHz Step	150 Milliseconds (max.)
1 MHz Step	350 Milliseconds (max.)

NOTE: Unlike other 2 Meter synthesizers the FM-DX does not have a lock-up delay when switching between Receive and Transmit.

ACCESSORIES AVAILABLE

MODEL 031A - 13.8 Volt, 10 Amp Base Station Power Supply and Speaker.

TRANSMIT OFFSET CRYSTALS: +1000 KHz, -1000KHz, +1035 KHz, -585 KHz. (Other offsets available on special order.

TOUCH TONE PAD - (Available in June)

II FRONT PANEL CONTROLS AND INDICATORS

A. POWER SWITCH:

The three position toggle switch serves the dual function of ON/OFF control and transmitter HIGH or LOW power selection.

B. FREQUENCY CONTROLS:

A total of 5 front panel controls are involved in the frequency selection process of the radio. Four of these are used to select Receive Frequency.

1. MHz SELECT (10 position rotary switch)
2. 100 KHz SELECT (10 position rotary switch)
3. 10 KHz SELECT (10 position rotary switch)
4. 0 or 5 KHz SELECT (2 position toggle switch)

The selected frequency is read directly on the 6 digit numeric LED display. (For operating convenience the 6th digit is blanked when a zero would be displayed; the first two digits are always 1 and 4.)

For example, to set the receiver to 146.52:

1. MHz SELECT rotated until third digit is 6
2. 100 KHz SELECT rotated until fourth digit is 5
3. 10 KHz SELECT rotated until fifth digit is 2
4. 0 or 5 KHz SELECT switch to 0 position

The FM-DX Receiver will then be precisely tuned to 146.52.

The remaining frequency control (affecting Transmit Frequency only) is the TRANSMIT OFFSET. The transmitter frequency is always related to the Receive Frequency. When the TRANSMIT OFFSET is in the SIMPLEX position the Transmit and Receive frequencies are identical.

Repeater operation simply requires setting the TRANSMIT OFFSET control to the setting appropriate to the particular repeater to be used.

For example, to work with a normal 146.13/146.73 repeater the Receiver would be set to the 146.73 repeater output; 146.73 would be displayed on the LED Readout. The TRANSMIT OFFSET would be set to -600; the transmitter would then be on the repeater input frequency, 146.13.

The TRANSMIT OFFSET control provides for 5 different repeater separations (in addition to Simplex). Simplex -600 KHz and +600 KHz are supplied as standard equipment. The user can supplement this capability at any time by adding a single plug in crystal for each additional separation required. No adjustments are required.

A PHASE LOCK INDICATOR light is located just above the TRANSMIT OFFSET control. This indicator will normally be extinguished but may flash on briefly when changing frequency. Transmission should not be made while this lamp is illuminated or flashing!

C. ADDITIONAL RECEIVER CONTROLS AND INDICATOR:

Conventional SQUELCH and VOLUME control are provided. The SQUELCH control, when advanced to the extreme clockwise position causes the radio to "mute" until a signal of approximately 25 microvolts is being received. When retarded (ccw) to the threshold point the receiver will be actuated by weak signals.

When the Fm-DX is in the receive mode the panel meter serves as a signal strength meter. Signals just barely perceptible will be indicated by a visible deflection of the meter and deflection will be in proportion to signal strength. Full scale deflection is achieved with an input signal strength of approximately 30 microvolts.

II INTERCONNECT AND ACCESSORY FACILITIES

MICROPHONE The FM-DX is supplied with a high quality dynamic PTT microphone fitted with a right angle, three pole male plug. The matching receptacle is located on the left side of the transceiver.

EXTERNAL SPEAKER A phono plug receptacle is located on the rear panel of the units to accomodate an external speaker wired with a conventional phono plug. Insertion of the external speaker automatically disables the internal speaker. Speaker impedance may be from 3.2 to 8 ohms.

ANTENNA CONNECTOR is a conventional UHF type located on the rear panel and accepts the standard PL259 coaxial connector.

POWER SUPPLY connection is made via a molded nylon polarized connector. The FM-DX is supplied with a fused cable with mating connector. Replacement or spare cables may be purchased from Clegg. (Order Assembly Number 0200020.) The in-line fuse is rated at 15 amps and is a conventional 32 volt automotive part. RED LEAD IS POSITIVE; BLACK IS NEGATIVE AND CASE GROUND

ACCESSORY RECEPTACLE

A 7 pin socket located on the right side of the transceiver affords provisions for inter-connection of accessory devices such as tone generators and remote controls.

Connections are:

1 Spare (not connected)
2 High side of VOLUME CONTROL
3 +9 volts DC (both TX and RX)
4 Parallel with microphone PTT control
5 Receiver audio (Parallel with speaker line)
6 Transmitter audio input (Parallel with microphone)
7 Ground

The Fm-DX owner will find this facility accomodates most requirements. Simple modifications would accomodate special requirements of accessory connections or controls. Consult Clegg Sales and Service if additional information is required.

IV MOBILE INSTALLATION (NEGATIVE GROUND SYSTEM ONLY)

The FM-DX, because of its significantly higher power rating than conventional transceivers, may require more care in installation. Current drain on HIGH POWER transmit may be as high as 10 amperes. To assure full performance the power cable between the battery source and the radio should be of sufficient conductor size to provide more than 12.3 volts at the transceiver.

Cigarette lighter adapters or alligator clip arrangements are not satisfactory for use with the FM-DX in the HIGH POWER mode. For temporary or emergency operation these expediencies may be employed if the transceiver is operated in the LOW POWER position.

The mobile mount supplied with the FM-DX provides flexibility and versatility of installation. No particular constraints on position or location are imposed by the radio itself; positioning the unit for operation accessibility would be the primary consideration. Where practical to do so the unit should be placed where direct sunlight is least apt to fall directly on the LED display. The speaker is located on the bottom of the unit therefore this area should remain unobstructed.

No radio works better than the antenna to which it is connected. Many choices exist for mobile installations. Where practical roof top mounting is superior to rear deck mounting and rear deck mounting is usually superior to bumper type mounts. Fresh, new coaxial cable should be used. RG-58 deteriorates measurable with age. If practical RG-8 is preferable. However, for the short lengths associated with mobile installations the difference may not be significant.

V BASE STATION INSTALLATION

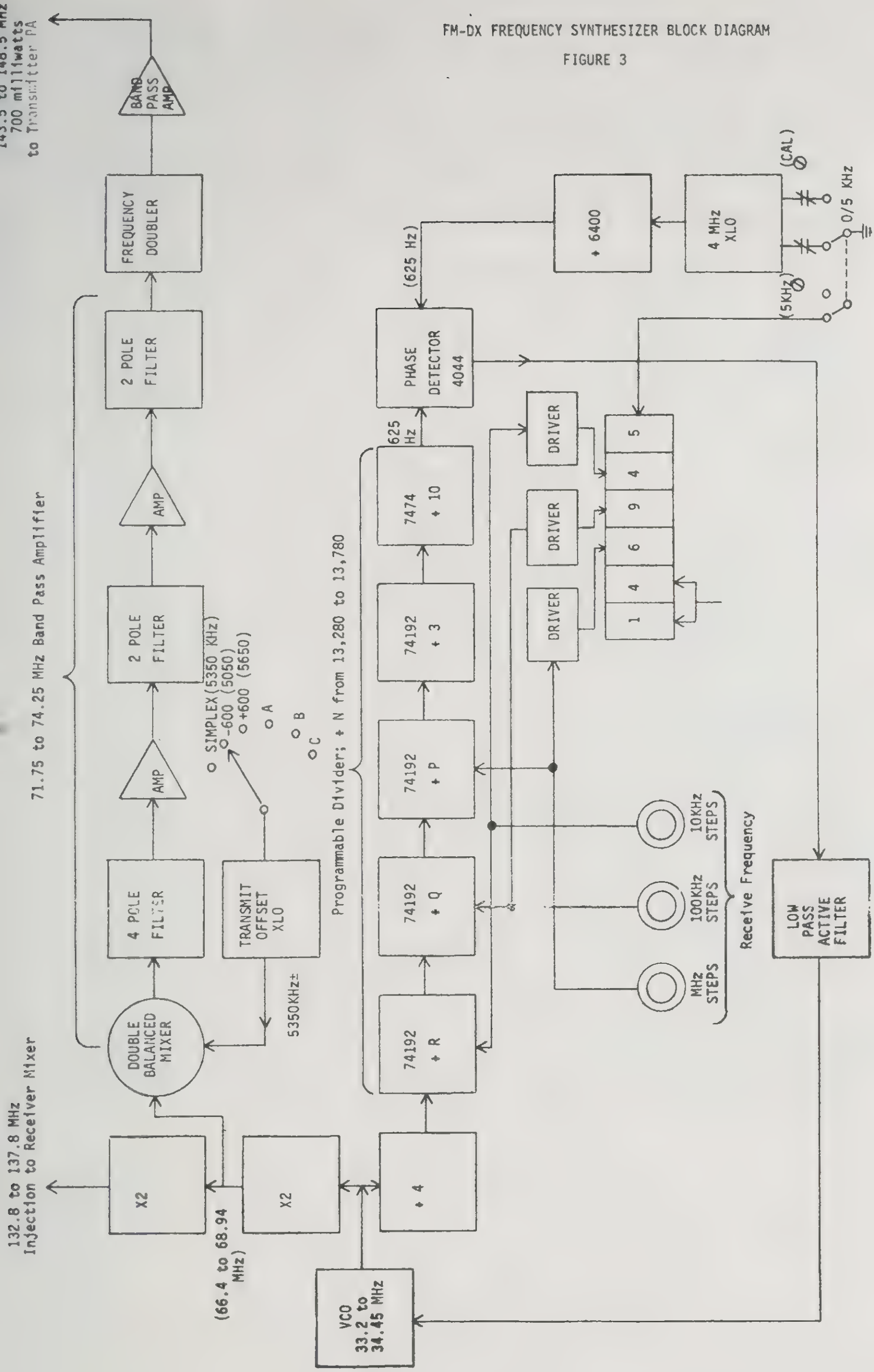
The extreme frequency versatibility of the FM-DX makes it an ideal unit for the FM'er who enjoys channel hopping from a base station. Unlike some earlier synthesized units the FM-DX has characteristics ideally suited for operation with large, high gain beam antenna for simplex DXing. Receiver design provides excellent freedom from overload and intermodulation; transmitter design provide an excellent spectrum purity.

Base operation requires a reasonably regulated power source capable of supplying 13.5 ± .5 VDC at 10 amperes. Regulation should be such that voltage does not fall below 12.3 volts at 10 amperes and does not rise above 14.5 volts at no load.

The Clegg Model 031A Power Supply provides an ideal base station power source for the FM-DX. In addition it includes an auxiliary speaker matched to the FM-DX.

Antenna selection for base station operation is very much a function of the owner's operation preferences and his geographical location. Most operation can be done with a simple omnidirectional vertical. However, a good vertically polarized beam may yield considerably expanded operating enjoyment in many cases. In addition to providing extended range for both Simplex and Repeater operation the beam permits the station who is located within range of two repeaters on the same frequency to access one without interfering with the other!

A most significant consideration in the base station, regardless of the antenna used, is the choice of coaxial feed line. When cable lengths of more than 50 feet or so are required RG8A/U is a must; where lengths of more than 100 feet are to be used the operator is wise to consider one of the lower loss cables. Reference is made to any of the VHF handbooks for information on the loss characteristics of available cables.



FM-DX FREQUENCY SYNTHESIZER BLOCK DIAGRAM

FIGURE 3

VI FREQUENCY CONTROL SYSTEM

DIGITAL SYNTHESIZER:

The FM-DX smploys digital counting technique and a phase locked voltage controlled oscillator (VCO) for direct generation of the injection signal for the receiver. The same phase locked VCO output is combined in a mixer along with the output of a switchable crystal oscillator to derive the transmitter frequency. A block diagram of this processing is shown in Fig. 2.

The VCO operates over the range from 33.2 MHz to 34.45 MHz. The output is frequency multiplied 4 times to provide the required 132.8 to 137.8 MHz receiver injection frequency.

Simultaneously, the VCO frequency is divided by 4 to yield a signal between 8300 and 8612.5 KHz. This latter signal feeds five cascaded programmable counters. The net count of these counters can be programmed by three panel controls so that they divide the input frequency by any selected number from 13,280 to 13,780. Output from the divider string provides one of two inputs to a phase detector. The second input is a fixed 625 Hz signal derived from a precise 4000 KHz crystal oscillator and a fixed divide-by-6400 digital circuit.

The phase detector employed (a Motorola MC4044) is of the type wherein a steady state output voltage exists only when both input and output signals are identical in both frequency and phase. In this application this condition is satisfied only when the divided down VCO frequency equals the 625 Hz reference frequency. The filter and DC amplifier circuits following the phase detector output are applied to the VCO and consequently tune the VCO to that frequency which satisfies this 625 Hz condition.

A numerical example is in order. Let us say our programmable divider is arbitrarily set to divide by 13,600. The phase detector filtered and amplified output will force the VCO to 13,600 x 4 x 625 Hz or 34.000 MHz. If the VCO tends to drift higher the 625 Hz resultant will also increase and the phase detector will respond with a corrective output voltage returning the VCO to the correct frequency. With the VCO locked on 34.000 MHz the receiver will be tuned to (34.0 x 4) + 10.7 MHz or 146.70 MHz.

Similarly, if we wish to change from 146.70 to 146.71 MHz we merely change the divider from the previous 13,600 number to 13,601. Each change of 1 in our divide numeral results in a 10 KHz change in receive frequency. Furthermore, our receive frequency in KHz is always 10 times our divide numeral plus 1070; i.e. 10(N + 1070) KHz.

The FM-DX controls and LED display have been programmed to do the above arithmetical computation internally. Consequently when the Receive Frequency controls are switched so that 146.70 is displayed on the LED's the divider is automatically set to the corresponding 13,600 value and the receiver is tuned to 146.70.

To accomodate the 5 KHz increments controlled by the 0/5KHz toggle switch the 4000 KHz reference oscillator is moved slightly in frequency and consequently, the 625 Hz reference moves a proportional amount. (The 5 KHz shift which results is only precise at one frequency, 147.00 MHz. However, the error in the 5 KHz shift is less than a 100 Hz at frequency extremes.)

TRANSMIT SYNTHESIZER:

The FM-DX is configured so that the transmit frequency is always slaved to the receive frequency. When the radio is in the Simplex mode the transmit frequency is the same as the receive frequency. For repeater operation the transmit frequency can be above or below the selected received frequency. In addition to the normal plus or minus 600 KHz repeater spacings the FM-DX will accomodate three additional choices of spacing. The TRANSMIT OFFSET switch controls this selection. Transmit frequency is produced by combining two signals in a solid state double balanced mixer:

1. The second harmonic of the VCO
2. The output of a switchable crystal oscillator

The sum of these two frequencies is then doubled in frequency and becomes our transmitter output frequency.

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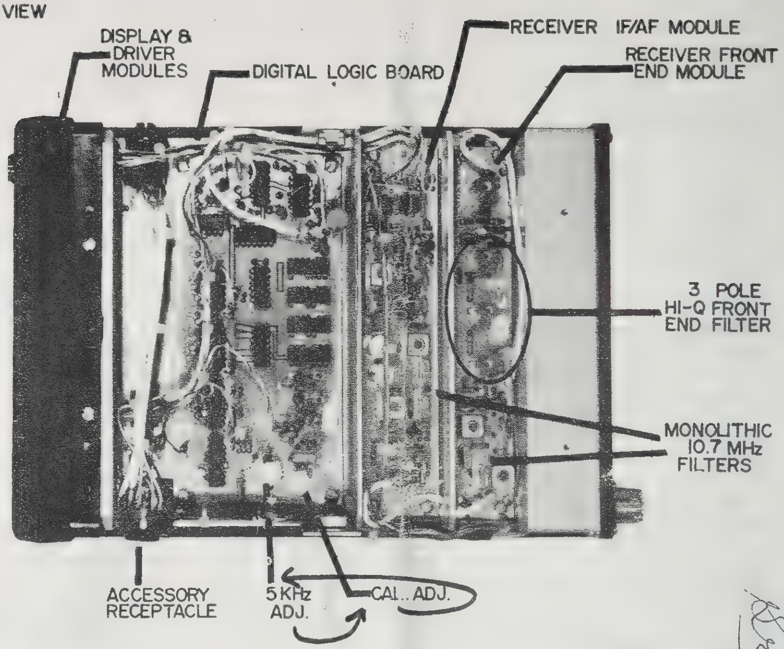
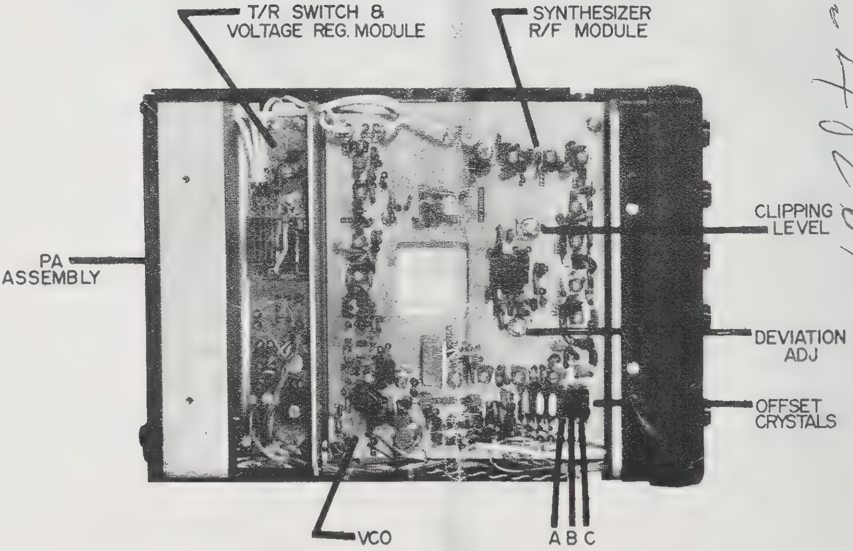


BOTTOM VIEW



WA4NWO

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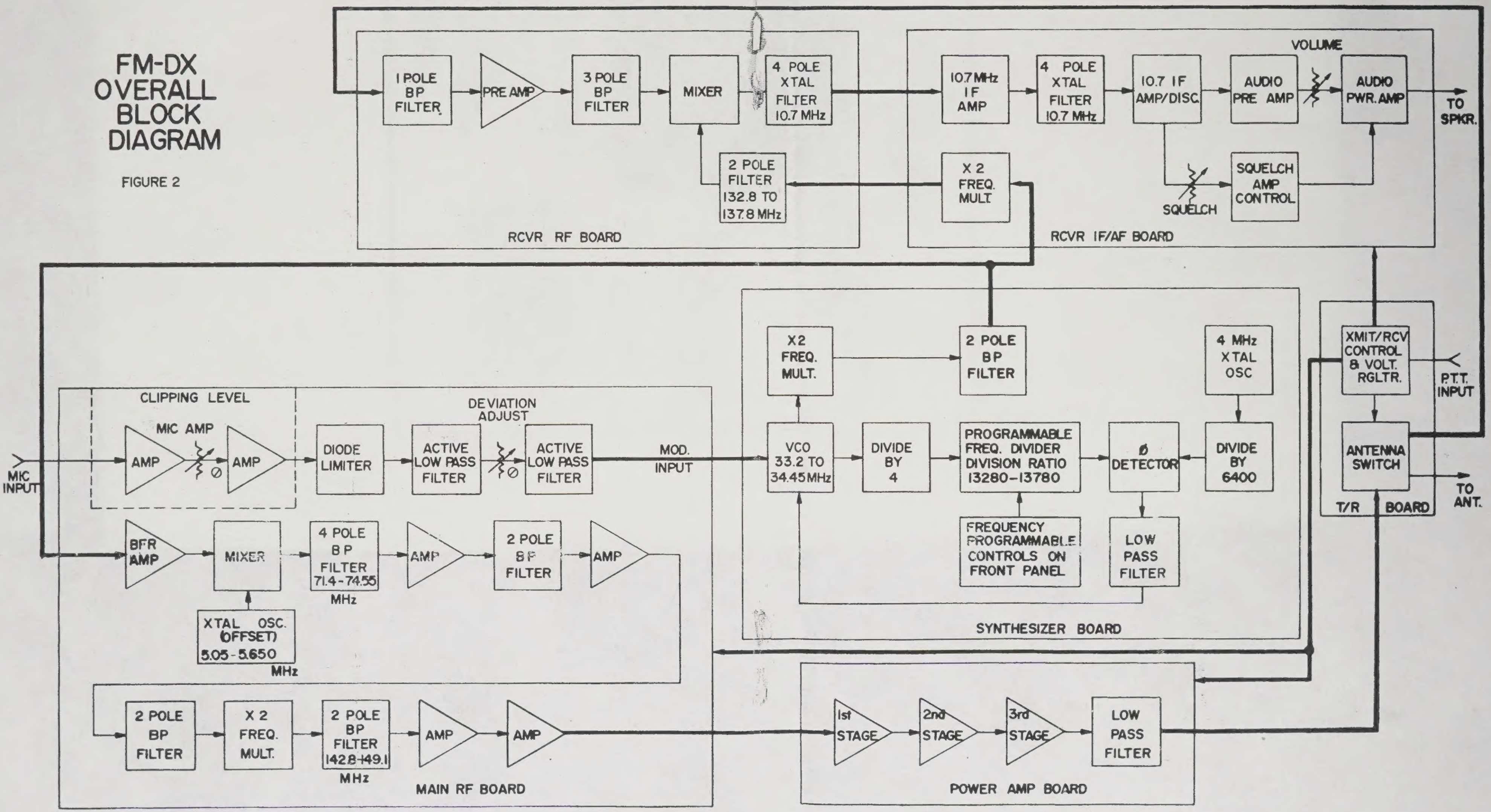
Bragg - 4826456

FM-DX OVERALL BLOCK DIAGRAM

FIGURE 2



THRESHOLD AT .15uv TO
TIGHT SQUELCH AT 30uv

LARGE, BRILLIANT LED
FREQUENCY READOUT
(6th digit lights for 5KHz)

ILLUMINATED METER. SIGNAL
STRENGTH ON RECEIVE; RELATIVE
OUTPUT ON TRANSMIT

SELECTS TRANSMITTER
POWER BETWEEN A BIG
30 + WATTS OR A COOL
1 WATT FOR LOCAL USE

FM-DX Amateur Net
$589.95

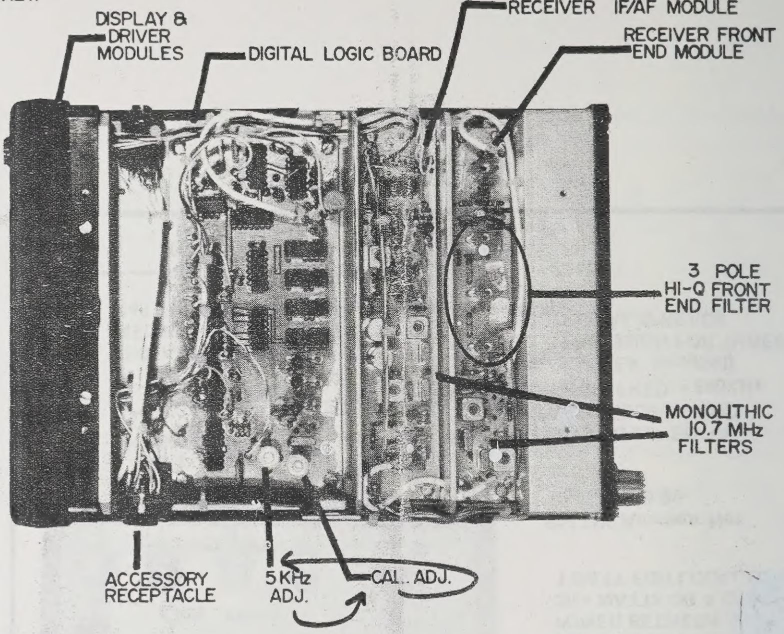
1MHz STEPS
100KHz STEPS
10KHz STEPS
0/5 KHz STEPS

SELECTS DIFFERENTIAL
BETWEEN RECEIVE AND
TRANSMIT FREQ. ±600KHz
AND SIMPLEX (supplied)
PLUS PROVISION FOR THREE
ADDITIONAL SPREADS

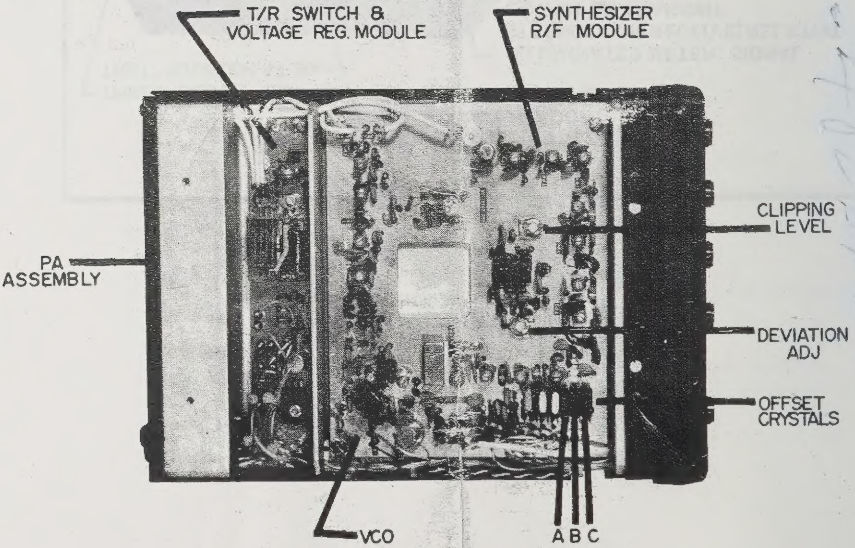
INSTANTLY DIAL UP ANY
RECEIVE FREQUENCY FROM
143.5 to 148.5MHz IN 5KHz STEPS!

ADJUST VOLUME UP
TO A LOUD 1.5 WATTS

TOP VIEW



BOTTOM VIEW



Wade WA4YBP

See 88

482-1456